HIPOWER®

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Rental Generating Sets Manual

John Deere
Yanmar
MTU

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1. SAFETY

1.1 General Safety Information

This manual provides information and procedures to safely operate and maintain your Hipower Generator Set. Read, understand and observe the safety instructions described in this manual before installing, operating and servicing the generator.

If you have questions about operation or service, please contact Hipower Systems. The information contained in this manual was based on machines in production at the time of publication. Himoinsa Power Systems reserves the right to change any portion of this information without notice.

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This manual is provided to assist in the maintenance and operation of the generator and is not to be used in any manner detrimental to the interests of Himoinsa Power systems.

Information in this manual represents components installed when product was manufactured based upon the best available information. Modifications made subsequent to initial delivery are not included. Always verify the parts required with Himoinsa Power Systems.

If you have any questions, please contact our Parts and Service Department.

Do not operate generator without an Operators Manual. Treat the Operators Manual as part of the generator. Replace the Operators Manual if it is lost, damaged or becomes unreadable.

All personnel that will be operating, maintaining and working around the generator must review these documents before interacting with the generator.

If you have any safety concerns or questions that are not covered by this manual, please contact Himoinsa Power Systems at 1-913-495-5557.

California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and some other reproductive harm.

Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

The safety information in this manual is denoted by the safety alert symbol:

The level of risk is indicated by the following signal words:

DANGER

Indicates a hazardous situation, which, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazardous situation, which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation, which, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates a situation that could result in damage to the equipment or other property.

Never go under raised equipment unless properly supported.

Use properly rated lifting equipment to lift heavy objects.

Extinguish all smoking material when adding fuel or working around generator. Engine must be stopped before adding fuel.

Clean up fluids and dispose of fluids, contaminated material etc. in accordance with local regulations.

Disconnect negative (-) battery cable before performing maintenance on generator set.

Allow components to cool before attempting any maintenance.

Do not operate generator set with safety guard(s) removed.

Seek medical attention immediately if your skin contacts high pressure fuel.

1.2 Installation And Transporting Hazards

WARNING

Crushing hazard.

Generator set is heavy.

Use properly rated lifting devices to move generator set.

Never enter the area under a raised generator set.

WARNING

The generator lifting points are designed to lift the generator only.

Do not lift the complete generating set by the generator lifting points.

WARNING

Incorrect installation and/or protective systems can result in injury and/or equipment damage.

Installers must be qualified to perform electrical installation work.

1.3 Operational Hazards

WARNING

Risk of death or serious injury.

Do not operate, work on or around this machine while under the influence of alcohol, drugs or if feeling ill.

WARNING

Carbon monoxide hazard.
Do not operate the generator in an enclosed building or confined area.
Avoid actions or areas that expose you and others to carbon monoxide.

WARNING

Entanglement hazard.

Loose fitting clothing and long hair can be come entangled in moving or rotating parts.
Do not wear loose fitting clothing.

Long hair must be tied back or netted.

Remove neck ties.

Do not operate generator with a guard removed or access panel removed.

You must adhere to local codes and regulations where your generator is being used.

Do not smoke while refueling. Do not refuel near sparks or an open flame.

Clean up fluid spills and contaminated material in accordance with local regulations.

WARNING

Ensure that all personnel operating, servicing, maintaining or working near this equipment are wearing appropriate Personal Protective Equipment (PPE) including eye and ear protection and are fully aware of the emergency procedures in case of any accidents.

WARNING

Generators emit noise.

Ensure appropriate ear protection is worn at all times. Maximum A-weighted emissions levels may reach 104 db.

1.4 Maintenance Hazards

Service and maintenance procedures must be carried out by experienced, qualified engineers, familiar with the procedures and the equipment. Before any intrusive procedures are carried out, ensure that the engine is inhibited and the generator is electrically isolated.

All electrical equipment can be dangerous if not operated correctly. Always service and maintain the generator in accordance with this

manual. Always use genuine replacement parts.

WARNING

Hot engine and exhaust system can cause severe injury.

Do not touch hot engine parts.

Do not perform service or maintenance on generator until cool to the touch.

WARNING

Risk of severed digits or limbs.

Generator can be started from a remote switch.

Disconnect the negative (-) battery cable from generator battery before performing service or maintenance on generator set.

WARNING

Electrical shock can cause injury or death.

Ensure that all personnel operating, servicing, maintaining or working near this equipment are fully aware of the emergency procedures in case of accidents.

WARNING

Do not handle Permanent Magnet Generators (PMGs) if you have mechanically implanted devices; ie pacemakers.

WARNING

Service and fault finding procedures present hazards which can result in injury or death. Only personnel qualified to perform electrical and mechanical service should carry out these procedures. Ensure engine starting circuits are disabled before commencing service or maintenance procedures. Isolate any anti-condensation heater supply.

California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

Battery posts, terminals and related accessories contain lead and leads compounds, chemicals known to the State of California to cause cancer, birth defects and other reproductive harm. Wash hands after handling.

2. STARTING INSTRUCTIONS 702

2.1 Starting Instructions 702

Check oil and coolant fluids before operating generator.

1. Turn on battery cut off switch by rotating to vertical position. Location label on other side front door. To disconnect rotate to horizontal position. (Located below battery charging alternator on the left side as you face the rear of the generator.)

2. Check emergency stops you will find one inside on the control panel and one located on the housing exterior. Twist clockwise to release.

3. Turn on rotary power switch located on lower right of control panel by emergency stop button.

4. Check selector for correct operating voltage before starting. It is located inside on the front of the generator, location label on left side vented door. **(DO NOT CHANGE VOLTAGE SELECTOR WHILE SET IS RUNNING).**

5. To start turn key to auto on DSE702 control.

6. Push green button and wait 10 seconds for glow plugs and engine will start.

7. Check for correct voltage and adjust dial labeled 'Voltage Adjustment Dial', if necessary. Move safety lock on top to left to release and back to right to lock.
For more information please see laminated instructions in manual box.

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2.2 Portable Power Quick Start Manual 702

Portable Power
Quick Start Manual

Quick overview of Rental set operations and functions.

HIPOWER® generating sets

- YANMAR GENERATING SETS | **25 to 50 KVA**

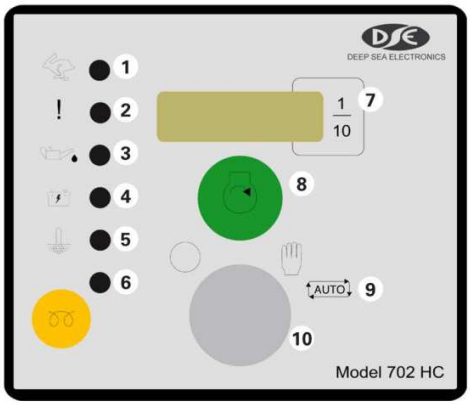
- Before using generator set **PLEASE** read these easy steps on operation:

2 Battery cut off switch.

4 Engine diagnostic switch & Panel power switch.

5 Selector switch.

1. Check all fluid levels before running the generator set.
2. Turn on the **battery cut off switch** located below the battery charging alternator (Red Handle). Rotate clockwise to vertical position.
3. To start the unit, turn key to the AUTO position, then push the **green button** marked with a hand to start it. Engine will preheat for 10 seconds before cranking.
4. **Engine diagnostic switch** can be used to power up the gauges while fueling unit. **DO NOT** turn on when running generator set.
5. Check the **selector switch** for the correct operating voltage. **DO NOT CHANGE POSITION OF SELECTOR WHILE GENERATOR IS RUNNING.** The switch is located on the front end of the generator box. To access it, open the left hand door by the vented panel.
6. This generator is equipped with a **DSE 702 control panel.** The illustration below shows all funtions and safety.



6 3 8 DSE 702 Control Panel.

Technical details: 1. Over speed, 2. Over crank, 3. Low oil pressure
4. Battery charge fault, 5. Over temperature, 6. Glow plugs, 7. Hour meter,
8. Start button (3), 9. Auto start position (8), 10. Key power switch.

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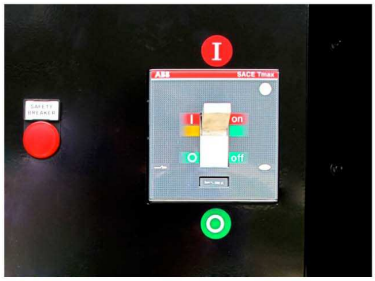
9 Over current relay. Technical details: 1. OCR Adjusment, 2. OCR test button, 3. OCR reset button.



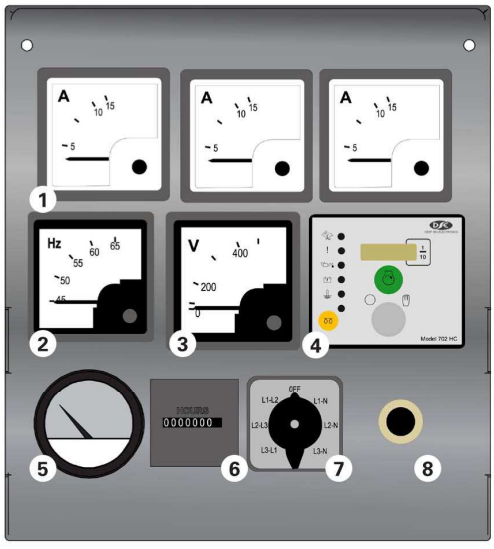
9 10 Safety breaker light & circuit breaker.

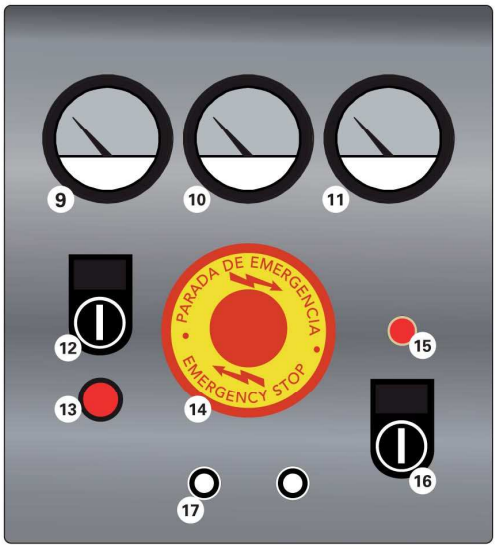
7 When the generator is running, check to make sure the voltage is correctly. If needed this can be regulated via the **voltage adjustment dial**. (**item 8** at the bottom left illustration)

8 **Auto start** is done by closing the contact connections located at the bottom of the main control panel. See complete Control Panel illustration to locate the 2 auto start connection knobs.

9 **Over current relay protection** only functions in 277/480 volt. If the relay trips and the safety breaker light is on, it will need to be reset. Push the pictured **blue button** to reset the over current relay.

10 NOTE: If the **circuit breaker door** is open, the breaker will not reset and the **safety breaker light** will stay on.





4 6 7 Complete Control Panel DSE 702

Technical details: 1. Three AC amp meters, 2. Frecuency meter, 3. Volt meter, 4. DSE 702 Control (6), 5. Battery volt meter, 6. Hour meter, 7. Voltage phase selector switch, 8. Voltage adjustment dial (7), 9. Fuel gauge 10. Oil pressure gauge, 11. Temperature gauge, 12. Engine diagnostic switch (4), 13. Block heater power switch (optional), 14. Emergency stop, 15. Basin alarm (optional), 16. Panel power switch (4). 17. Auto start connections.

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3. STARTING INSTRUCTIONS 3110

3.1 Starting Instructions 3110

Please read laminated instructions before operating generator, located in manual box. Manual box located inside of door marked 'Manuals' with colored label.

Check oil and coolant fluids before operating generator.

1. Turn on battery cut off switch by turning to right. Turn back left to off position (located by the starter motor).

2. Check emergency stops (twist clockwise to release). One is located on lower portion of control panel and one is located on outside of housing.

3. Turn on rotary power switch located on lower right of control panel by emergency stop button.

4. Check selector for correct operating voltage before starting. It is located inside on the front of the generator, location label on left side vented door. **(DO NOT CHANGE VOLTAGE SELECTOR WHILE SET IS RUNNING).**

5. To start push red reset button and then the green button to start.

6. Check for correct voltage, adjust with voltage adjustment dial (labeled) if necessary. Move safety lock to left to release and back to right to lock.

For more information please see laminated instructions in manual box.

3.2 Portable Power Quick Start Manual 3110

Portable Power
Quick Start Manual

Quick overview of Rental set operations and functions.

HIPOWER® generating sets

- JOHN DEERE GENERATING SETS | **35 to 460 KVA**

- Before using generator set **PLEASE** read these easy steps on operation:

2 Battery cut off switch.

1. Check all fluid levels before running the generator set.
2. Turn on the **battery cut off switch** located by the engine starter housing.
3. To start the unit, turn key to the AUTO position, then push the **green button** marked with a I to start. Engine will preheat for 10 seconds if equipped with glow plugs before starting.
4. **Engine diagnostic switch** can be used to power up the gauges while fueling unit. **DO NOT** turn on when running generator set.
5. Check the **selector switch** for correct operating voltage, **DO NOT CHANGE POSITION OF SELECTOR WHILE GENERATOR IS RUNNING** it's located on the generator end box on the front end. To access it, open the left hand door by the vented panel.
6. This generator is equipped with a **DSE 3110 control panel**. The illustration below shows all funtions and safety.

4 Engine diagnostic switch.

5 Selector switch.

5 6 7 DSE 3110 Control Panel.

Technical details: 1. Navigation Button, 2. Main status display, 3. Common alarm indicator, 4. Stop/Reset button, 5. Auto start (7), 6. Start button (6).

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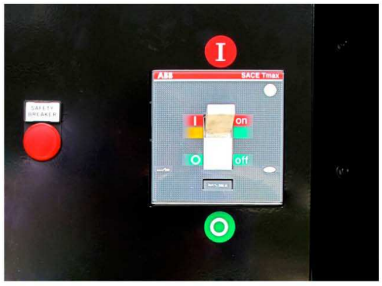
8 Over current relay. Technical details: 1. OCR Adjusment, 2. OCR test button, 3. OCR reset button.



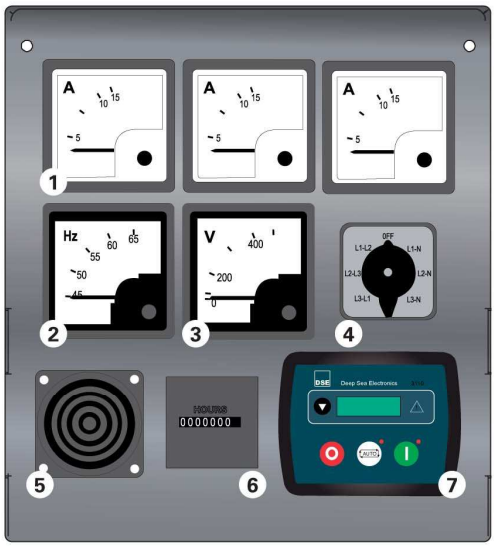
9 10 Safety breaker light & circuit breaker.

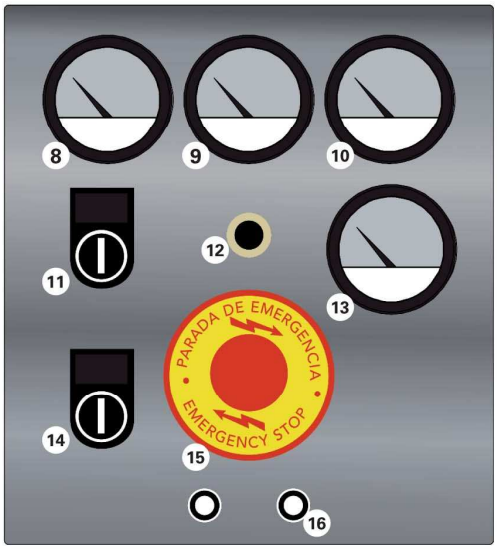
7 When the generator is running, check to make sure the voltage is correctly, (See **item 12** in the technical detail section on the complete Control Panel illustration) this can be regulated with the **voltage adjustment dial**.

8 **Auto start** is done by pushing the **white AUTO button**. Close the auto start contact connections located at the bottom of the main control panel and the unit will start in Auto. See complete Control Panel illustration to locate the 2 auto start connection knobs.

9 **Over current relay protection** only functions in 277/480 volt. If the relay trips and the safety breaker light is on, it will need to be reset. Push the pictured **blue button** to reset the over current relay.

10 NOTE: If the **circuit breaker door** is open, the breaker will not reset and the **safety breaker light** will stay on.





4 6 7 Complete Control Panel DSE 3110

Technical details: 1. Three AC amp meters, 2. Frecuency meter, 3. Volt meter, 4. Volt meter switch, 5. Alarm buzzer , 6. Hour meter, 7 DSE 3110 Control (6). , 8. Fuel gauge, 9. Oil gauge, 10. Temperature gauge, 11. Engine diagnostic switch (4), 12. Voltage adjustment dial (7), 13. Volt meter, 14. Panel power switch, 15. Emergency stop, 16. Auto start connections.

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4. STARTING INSTRUCTIONS 8610

4.1 Starting Instructions 8610

Manual box is located inside of the door marked with Orange decal "MANUAL BOX"

1.) Check Oil and Coolant fluids before operating generator.

2.) Turn ON battery cut off switch by turning lever to the right hand. Turn lever to the left position of OFF. Cut off switch is near the starter motor located inside door marked with Red decal "BATTERY CUT OFF SWITCH".

3.) Check and reset Emergency stop switches (Twist clockwise to release). One is located on the lower portion of control panel and second and third device is located outside of housing.

4.) Turn on rotary power switch located near the emergency stop button on the lower right portion of the control panel.

5.) Check Voltage change over board for the correct operating voltage before starting equipment. Change over board located on the end of the generator. **WARNING: DO NOT CHANGE VOLTAGE while equipment is running.**

6.) To start, push RED reset button, the Hand and then the GREEN button on the DSE 8610 controller.

7.) Once the generator is running, the voltage will automatically change to correct operating voltage when breaker is on.

5. DESCRIPTION OF OPERATION

5.1 Description of Operation

5.1.1 Manual Mode Operation

To initiate a start sequence in **MANUAL**, turn the key to the position. To start the set, press the I button. Preheating will begin, indicated by the LED.

NOTE:- There is no Start Delay in this mode of operation. Starting will commence as soon as the start button is pressed.

The **Fuel Solenoid** is energised, then the **Starter Motor** is engaged.

The engine is cranked for a 10-second period. If the engine fails to fire during this cranking attempt then the starter motor is disengaged for a 10-second period. Should this sequence continue beyond the 3 starting attempts, the start sequence will be terminated and **Fail to Start** fault will be illuminated.

When the engine fires, the starter motor is disengaged and locked out at 20 Hz measured from the Alternator output.

After the starter motor has disengaged, the **Safety On** timer is activated (which is fixed at 10 seconds), allowing Oil Pressure, High Engine Temperature, Under-speed and Charge Fail to stabilise without triggering the fault.

Selecting **STOP** O de-energises the **FUEL SOLENOID**, bringing the generator to a stop.

5.1.2 Automatic Mode of Operation

To initiate a start sequence in **AUTO**, turn the key to the position.
The start sequence is initiated when the remote start input is activated.

After a fixed 5 second start delay, Preheating will occur (fixed at 10s) , indicated by the LED. the **Fuel Solenoid** is energised, then one second later, the **Starter Motor** is engaged.

The engine is cranked for a 10-second period. If the engine fails to fire during this cranking attempt then the starter motor is disengaged for a 10-second rest period. Should this sequence continue beyond the 3 starting attempts, the start sequence will be terminated and

Fail to Start fault will be illuminated.

When the engine fires, the starter motor is disengaged and locked out at 20 Hz measured from the Alternator output..

After the starter motor has disengaged, the **Safety On** timer is activated, allowing Oil Pressure, High Engine Temperature, Under-speed and Charge Fail to stabilise without triggering the fault.

On removal of the **Remote Start** signal the **Stop** delay timer is initiated. Once this timer has expired the **Fuel Solenoid** is de-energised, bringing the generator to a stop.

5.2 Warnings

Warnings are used to warn the operator of an impending fault

BATTERY CHARGE FAILURE, if the module does not detect a voltage from the warning light terminal on the auxiliary charge alternator, the icon will illuminate.

5.3 Shutdowns

Shutdowns are latching and stop the Generator. The alarm must be cleared, and the fault removed to reset the module. In the event of a shutdown the appropriate LED will be illuminated

NOTE:- The alarm condition must be rectified before a reset will take place. If the alarm condition remains it will not be possible to reset the unit (The exception to this is the Low Oil Pressure alarm and similar 'delayed alarms', as the oil pressure will be low with the engine at rest).

FAIL TO START, if the engine does not fire after the pre-set 3 attempts at starting, a shutdown will be initiated.
The icon will illuminate.

LOW OIL PRESSURE, if the module detects that the engine oil pressure has fallen below the low oil pressure switch after the **Safety On** timer has expired, a shutdown will occur.
The icon will illuminate.

HIGH ENGINE TEMPERATURE if the module detects that the engine coolant temperature has exceeded the high engine temperature switch after the **Safety On** timer has expired, a shutdown will occur.
The icon will illuminate.

OVERSPEED, if the engine speed exceeds the pre-set trip (14% above the nominal frequency) a shutdown is initiated. Overspeed is not delayed, it is an **immediate shutdown.**
The icon will illuminate.

NOTE:- During the start-up sequence the overspeed trip level is extended to 24% above the normal frequency for the duration of the safety timer to allow an extra trip level margin. This is used to prevent nuisance tripping on start-up.

UNDERSPEED, if the engine speed falls below 20Hz (fixed) after the **Safety On** timer has expired, a shutdown is initiated.
The icon will flash.

NOTE:- The icon is used to indicate both underspeed and overspeed. A flashing icon indicates underspeed. A steady icon indicates overspeed.

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6. 3110 SERIES CONTROL PANEL

6.1 Description Of Controls

The following section details the function and meaning of the various controls on the module.

1 - Navigation Buttons
2 - Main Status Display
3 - Common Alarm Indicator
4 - Start engine.
5 - Select Auto Mode
6 - Select Stop Mode

6.2 Quickstart Guide

This section provides a quick start guide to the module's operation.

6.2.1 Starting The Engine

1. First press Stop/Reset (1).

2. Then, press the Start button to crank the engine. Depending upon module configuration, two presses may be required.

6.2.2 Stopping The Engine

1. Select Stop/Reset mode (1). The generator is stopped.

6.3 Graphical Display

A 32x132 pixel LCD (35mm / 1.4") is available for the display of generator instrumentation and alarm conditions. The display is segmented into areas for instrumentation, unit, alarm icons and for Front Panel Editor (FPE) use.

When not in the Front Panel Editor (FPE) mode the FPE area of the display is used to display the currently active configuration. The letter 'M' is displayed for main configuration active, the letter 'A' for alternative configuration active.

VIEWING THE INSTRUMENTS

It is possible to scroll to display the different pages of information by repeatedly operating the scroll button.

Once selected the page will remain on the LCD display until the user selects a different page or after an extended period of inactivity, the module will revert to the status display.

When scrolling manually, the display will automatically return to the Status page if no buttons are pressed for the duration of the configurable LCD Page Timer.

If an alarm becomes active while viewing the status page, the display shows the Alarms page to draw the operator's attention to the alarm condition. Page order:

Engine Speed
Generator Volts
Generator Frequency
Engine Run Time
Battery Volts

6.4 Controls

Stop / Reset

This button places the module into its Stop/ Reset mode. This will clear any alarm conditions for which the triggering criteria have been removed. If the engine is running and the module is in Stop mode, the module will automatically instruct the changeover device to unload the generator ('Close Generator' becomes inactive (if used)). The fuel supply de-energizes and the engine comes to a standstill. Should a remote start signal be present while operating in this mode, a remote start will not occur.

Auto

This button places the module into its 'Automatic' mode. This mode allows the module to control the function of the generator automatically. The module will monitor the remote start input and once a start request is made, the set will be automatically started and laced on load. Upon removal of the starting signal, the module will automatically transfer the load from the generator and shut the set down observing the stop delay timer and cooling timer as necessary. The module will then await the next start event.

Start

Pressing this button in auto mode will start the engine and run off load. Pressing this button in STOP/RESET mode will turn on the CAN engine ECU (when correctly configured and fitted to a compatible engine ECU).

Page

Pressing this button scrolls the display to show the various instruments.

6.5 Automatic Mode Of Operation

NOTE:- If a digital input configured to panel lock is active, changing module modes will not be possible. Viewing the instruments and event logs is NOT affected by panel lock.

Activate auto mode by pressing the AUTO pushbutton. The line/arrow icon around AUTO is displayed to indicate Auto Mode operation if no alarms are present.

Auto mode will allow the generator to operate fully automatically, starting and stopping as required with no user intervention.

6.5.1 Waiting In Auto Mode

If a starting request is made, the starting sequence will begin. Starting requests can be from the following sources:

Activation of an auxiliary input that has been configured to remote start.

6.5.2 Starting Sequence

To allow for 'false' start requests, the start delay timer begins.

Should all start requests be removed during the start delay timer, the unit will return to a stand-by state.

If a start request is still present at the end of the start delay timer, the fuel relay is energized and the engine will be cranked.

NOTE: If the unit has been configured for CAN, compatible ECU's will receive the start command via CAN.

If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the crank rest duration after which the next start attempt is made. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and the display shows Fail to Start.

When the engine fires, the starter motor is disengaged. Speed detection is factory configured to be derived from the main alternator output frequency but can additionally be measured from a Magnetic Pickup mounted on the flywheel (Selected by PC using the 3000 series configuration software).

Additionally, rising oil pressure can be used to disconnect the starter motor (but cannot detect underspeed or overspeed).

NOTE: If the unit has been configured for CAN, speed sensing is via CAN.

After the starter motor has disengaged, the Safety On timer activates, allowing Oil Pressure, High Engine Temperature, Under-speed, Charge Fail and any delayed Auxiliary fault inputs to stabilize without triggering the fault.

ENGINE RUNNING

Once the engine is running and all starting timers have expired, the animated icon is displayed.

DSE3110 - The generator will be placed on load if configured to do so.

NOTE: The load transfer signal remains inactive until the Oil Pressure has risen. This prevents excessive

wear on the engine.

If all start requests are removed, the stopping sequence will begin.

6.5.3 Stopping Sequence

The return delay timer operates to ensure that the starting request has been permanently removed and isn't just a short term removal. Should another start request be made during the cooling down period, the set will return on load.

If there are no starting requests at the end of the return delay timer, the load is removed from the generator to the mains supply and the cooling timer is initiated.

The cooling timer allows the set to run off load and cool sufficiently before being stopped. This is particularly important where turbo chargers are fitted to the engine.

After the cooling timer has expired, the set is stopped.

6.6 Manual Operation

NOTE:- If a digital input configured to panel lock is active,
changing module modes will not be possible. Viewing the instruments and event logs is NOT affected by panel lock.

Manual mode allows the operator to start and stop the set manually, and if required change the state of the load switching devices. Module mode is active when the button is pressed.

6.6.1 Waiting In Manual Mode

To begin the starting sequence, press the button. If 'protected start' is disabled, the start sequence begins immediately.

If 'Protected Start' is enabled, the icon is displayed to indicate Manual mode and the manual LED flashes. The button must be pressed once more to begin the start sequence.

6.6.2 Starting Sequence

NOTE: There is no start delay in this mode of operation. The fuel relay is energized and the engine is cranked.
NOTE:- If the unit has been configured for CAN, compatible ECU's will receive the start command via CAN.

If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the crank rest duration after which the next start attempt is made. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and the display shows Fail to Start.

When the engine fires, the starter motor is disengaged. Speed detection is factory configured to be derived from the main alternator output frequency but can additionally be measured from a Magnetic Pickup mounted on the flywheel (Selected by PC using the 3000 series configuration software).

Additionally, rising oil pressure can be used disconnect the starter motor (but cannot detect underspeed or overspeed). NOTE:- If the unit has been configured for CAN, speed sensing is via CAN.

After the starter motor has disengaged, the Safety On timer activates, allowing Oil Pressure, High Engine Temperature, Under-speed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

Engine Running

In manual mode, the load is not transferred to the generator unless a 'loading request' is made. A loading request can come from a number of sources.

- Activation of an auxiliary input that has been configured to remote start on load
- Activation of the exercise scheduler if configured for 'on load' runs.

NOTE: The load transfer signal remains inactive until the Oil Pressure has risen. This prevents excessive wear on the engine.

Once the load has been transferred to the generator, it will not be automatically removed. To manually transfer the load back to the mains either:

- Press the auto mode button to return to automatic mode The set will observe all auto mode start requests and stopping timers before beginning the Auto mode stopping sequence.
- Press the stop button
- De-activation of an auxiliary input that has been configured to remote start on load.

6.6.3 Stopping Sequence

In manual mode the set will continue to run until either:

- The stop button is pressed – The set will immediately stop.
- The auto button is pressed. The set will observe all auto mode start requests and

stopping timers before beginning the Auto mode stopping sequence.

Protections

When an alarm is present, the Common alarm LED if configured will illuminate.

The LCD display will show an icon to indicate the failure.

6.7 Warnings

Warnings are non-critical alarm conditions and do not affect the operation of the generator system, they serve to draw the operators attention to an undesirable condition.

Warning alarms are self-resetting when the fault condition is removed. The icon will appear steady in the display.

6.8 Shutdowns

Shutdowns are critical alarm conditions that stop the engine and draw the operator's attention to an undesirable condition.

Shutdown alarms are latching. The fault must be removed and the button pressed to reset the module. The icon will appear flashing in the display.

6.9 Module Display

6.9.1 Timer Icon

When the module is controlling the engine (starting and stopping) an animated timer icon will be displayed in the icon area to indicate that a timer is active, for example cranking time, crank rest etc.

6.9.2 Stopped Icon

When there are no alarms present, an icon will be displayed to indicate the engine is stopped and what mode the unit is in.

Stop Mode

Auto Mode

Manual Mode

The hand is only displayed when the 'arming options' is enabled, otherwise the engine starts when entering the manual mode.

6.9.3 Running Icon

When there are no alarms present, an animated icon is displayed to indicate the engine is running.

6.9.4 USB Icon

When a USB connection is made to the module the USB icon is displayed.

6.9.5 Memory Corruption

If either the config file or engine file becomes corrupted the unit will display the icon.

6.9.6 Backlight

The backlight will be on if the unit has sufficient voltage on the power connection while the unit is turned on, unless the unit is cranking for which the backlight will be turned off.

6.10 Fault Icons

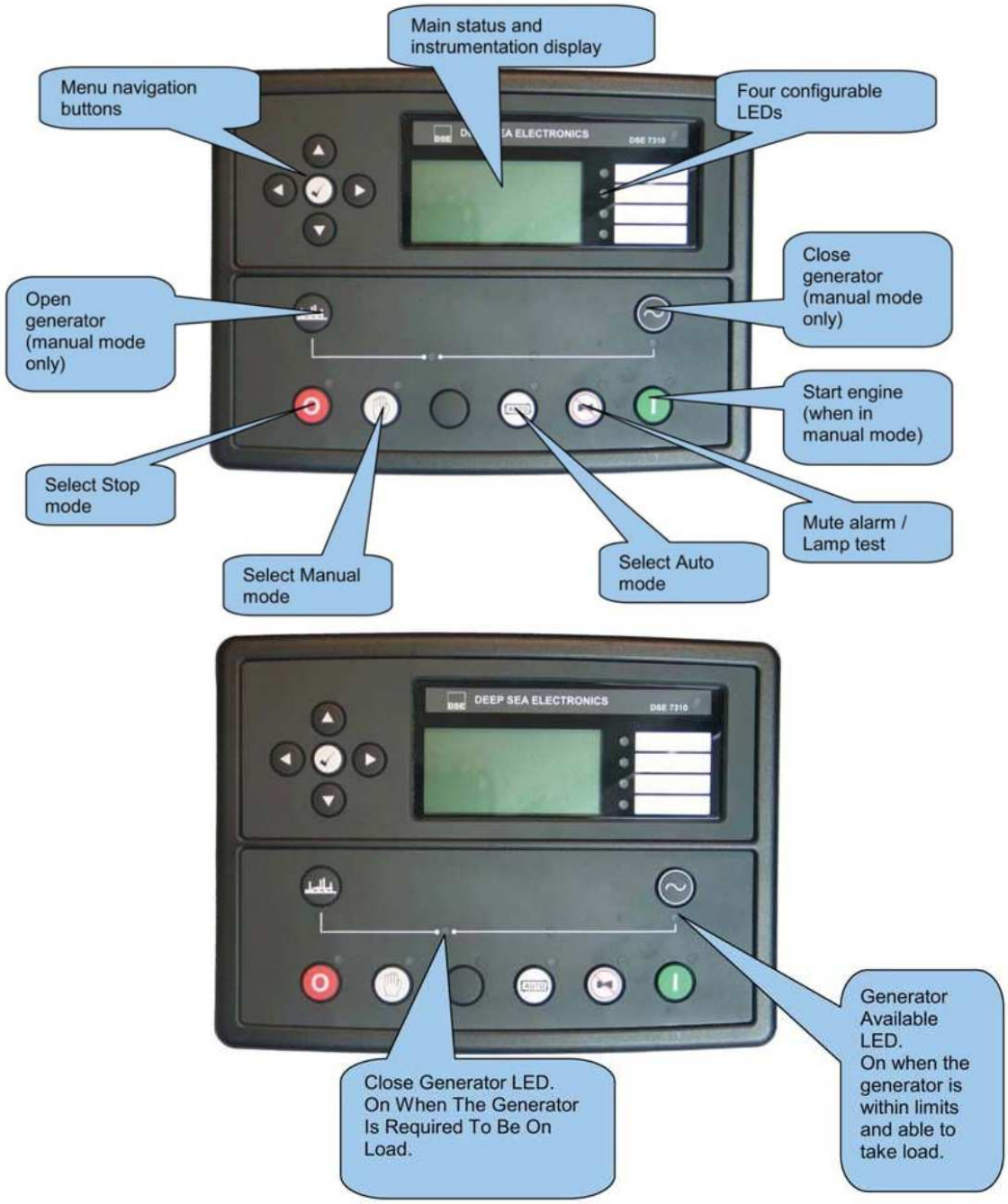
ICON	DESCRIPTION	
	AUXILIARY INPUTS	Auxiliary inputs can be user configured and will display the message as written by the user.
	FAIL TO START	The engine has not fired after the preset number of start attempts
	FAIL TO STOP	The module has detected a condition that indicates that the engine is running when it has been instructed to stop.
		NOTE:- 'Fail to Stop' could indicate a faulty oil pressure sensor - If engine is at rest check oil sensor wiring and configuration.
	LOW OIL PRESSURE	The module detects that the engine oil pressure has fallen below the low oil pressure pre-alarm setting level after the *Safety On* timer has expired.
	ENGINE HIGH TEMPERATURE	The module detects that the engine coolant temperature has exceeded the high engine temperature pre-alarm setting level after the *Safety On* timer has expired.
	UNDERSPEED	The engine speed has fallen below the underspeed pre alarm setting
	OVERSPEED	The engine speed has risen above the overspeed pre alarm setting
	CHARGE FAILURE	The auxiliary charge alternator voltage is low as measured from the W/L terminal.
	LOW FUEL LEVEL	The level detected by the fuel level sensor is below the low fuel level setting.
	BATTERY UNDER VOLTAGE / BATTERY OVER VOLTAGE	The DC supply has fallen below or risen above the low/high volts setting level.
	GENERATOR UNDER VOLTAGE	The generator output voltage has fallen below the pre-set pre-alarm setting after the *Safety On* timer has expired.
	GENERATOR OVER VOLTAGE	The generator output voltage has risen above the pre-set pre-alarm setting.
	GENERATOR UNDER FREQUENCY	The generator output frequency has fallen below the pre-set pre-alarm setting after the *Safety On* timer has expired.
	GENERATOR OVER FREQUENCY	The generator output frequency has risen above the pre-set pre-alarm setting.
	CAN ECU WARNING CAN ECU SHUTDOWN	The engine ECU has detected an alarm – CHECK ENGINE LIGHT **Contact Engine Manufacturer for support**.
	CAN DATA FAIL	The module is configured for CAN operation and does not detect data on the engine Can datalink.
	EMERGENCY STOP	The emergency stop button has been depressed. This a failsafe (normally closed to battery positive) input and will immediately stop the set should the signal be removed. Removal of the battery positive supply from the emergency stop input will also remove DC supply from the Fuel and Start outputs of the controller.
		NOTE:- The Emergency Stop Positive signal must be present otherwise the unit will shutdown.
	MAGNETIC PICKUP FAILURE	Pulses are no longer being detected from the magnetic pickup probe (3110-xxx-01 magnetic pickup version only)
	INTERNAL MEMORY ERROR	Either the configuration file or engine file memory is corrupted. Contact your supplier for assistance.

7. 7300 & 8600 SERIES CONTROL PANEL

7.0 Description of Controls

The following section details the function and meaning of the various controls on the module.

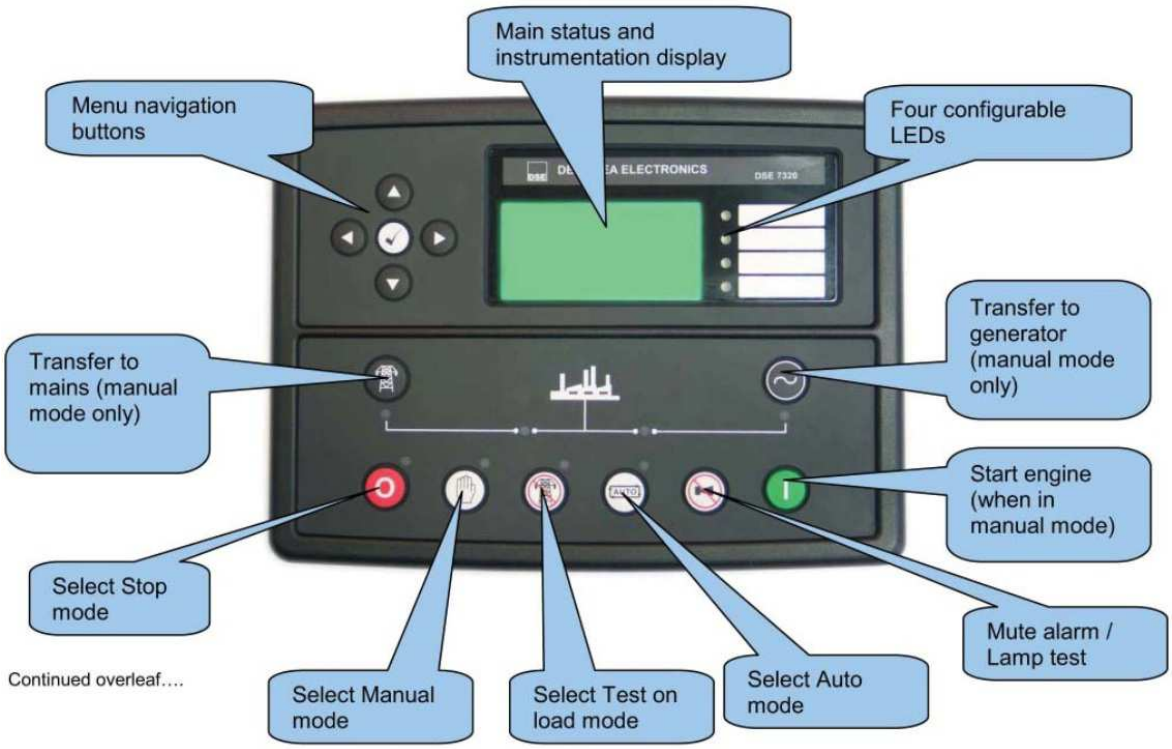
7.1 Autostart Control Module

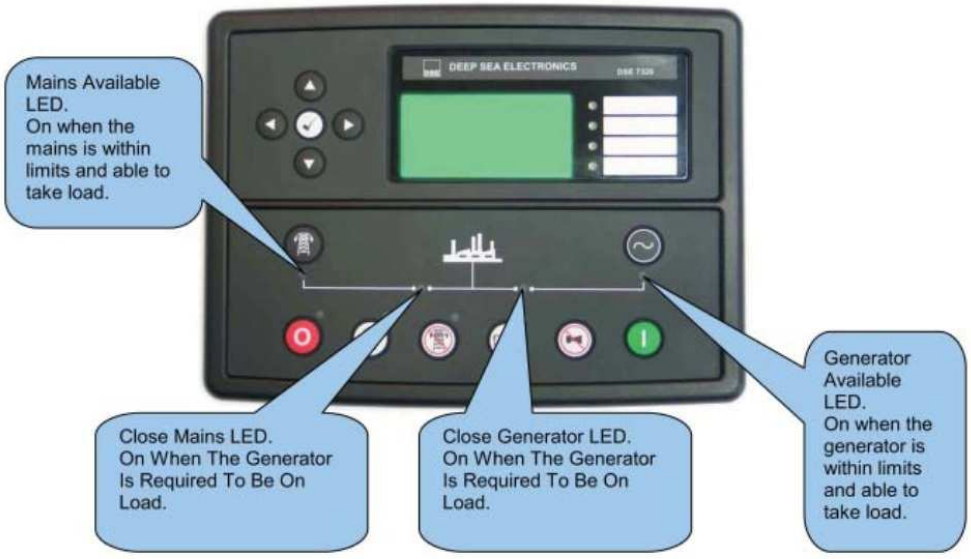

Main status and instrumentation display
Menu navigation buttons
Four configurable LEDs
Close generator (manual mode only)
Open generator (manual mode only)
Start engine (when in manual mode)
Select Stop mode
Mute alarm / Lamp test
Select Manual mode
Select Auto mode
DEEP SEA ELECTRONICS
DSE 7310
Generator Available LED. On when the generator is within limits and able to take load.
Close Generator LED. On When The Generator Is Required To Be On Load.

NOTE:- "Generator on load" LED has two modes of operation depending upon the configuration of the controllers digital inputs.

1) **Digital input configured for "Generator closed auxiliary" – The LED illuminates when the generator closed auxiliary input is active – The LED shows the state of the auxiliary contact.**
2) **There is NO input configured for "Generator closed auxiliary" (factory default setting) – The LED illuminates when the 7x20 gives the loading signal to the generator – The LED shows the state of the 7x20's loading request.**

7.2 AMF Control Module


Main status and instrumentation display
Menu navigation buttons
Four configurable LEDs
Transfer to mains (manual mode only)
Transfer to generator (manual mode only)
Start engine (when in manual mode)
Select Stop mode
Mute alarm / Lamp test
Continued overleaf….
Select Manual mode
Select Test on load mode
Select Auto mode


Mains Available LED. On when the mains is within limits and able to take load.
Close Mains LED. On When The Generator Is Required To Be On Load.
Close Generator LED. On When The Generator Is Required To Be On Load.
Generator Available LED. On when the generator is within limits and able to take load.

NOTE:- "Generator on load" LED has two modes of operation depending upon the configuration of the controllers digital inputs.

3) **Digital input configured for "Generator closed auxiliary" – The LED illuminates when the generator closed auxiliary input is active – The LED shows the state of the auxiliary contact.**
4) **There is NO input configured for "Generator closed auxiliary" (factory default setting) – The LED illuminates when the 7x20 gives the loading signal to the generator – The LED shows the state of the 7x20's loading request.**

NOTE:- "Mains on load" LED has two modes of operation depending upon the configuration of the controllers digital inputs.

5) **Digital input configured for "Mains closed auxiliary" – The LED illuminates when the mains closed auxiliary input is active – The LED shows the state of the auxiliary contact.**
6) **There is NO input configured for "Mains closed auxiliary" (factory default setting) – The LED illuminates when the 7x20 gives the loading signal to the mains – The LED shows the state of the 7x20's loading request.**

7.3 Quickstart Guide

This section provides a quick start guide to the module's operation.

7.3.1 Starting the Engine

NOTE:- For further details, see the section entitled 'OPERATION' elsewhere in this manual.

7.3.2 Stopping the Engine

NOTE:- For further details, see the section entitled 'OPERATION' elsewhere in this manual.

7.4 Viewing the Instrument Pages

It is possible to scroll to display the different pages of information by repeatedly operating the next / previous page buttons .

If you want to view one of the instrument pages towards the end of the list, it may be quicker to scroll left through the pages rather than right!

Example

Status Engine Generator

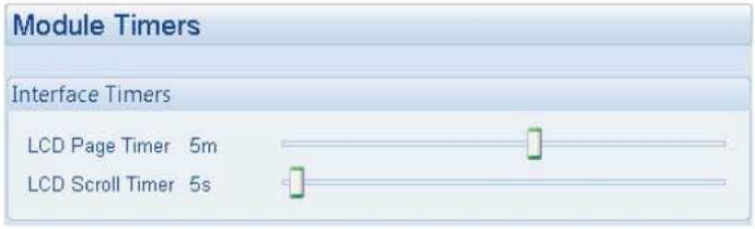
And so on until the last page is reached.
A Further press of the scroll right button, returns the display to the Status page.

The complete order and contents of each information page are given in the following sections

Once selected the page will remain on the LCD display until the user selects a different page, or after an extended period of inactivity (*LCD Page Timer*), the module will revert to the status display.

If no buttons are pressed upon entering an instrumentation page, the instruments will be displayed automatically subject to the setting of the *LCD Scroll Timer*.

The *LCD Page* and *LCD Scroll* timers are configurable using the DSE Configuration Suite Software or by using the Front Panel Editor.



The screenshot shows the factory settings for the timers, taken from the DSE Configuration Suite Software.

Alternatively, to scroll manually through all instruments on the currently selected page, press the scroll buttons. The 'autoscroll' is disabled.

If you want to view one of the instruments towards the end of the list, it may be quicker to scroll up through the instruments rather than down!

To re-enable 'autoscroll' press the scroll buttons to scroll to the 'title' of the instrumentation page (ie Engine). A short time later (the duration of the *LCD Scroll Timer*) the instrumentation display will begin to autoscroll.

When scrolling manually, the display will automatically return to the Status page if no buttons are pressed for the duration of the configurable *LCD Page Timer*.

If an alarm becomes active while viewing the status page, the display shows the Alarms page to draw the operator's attention to the alarm condition.

7.4.1 Status

This is the 'home' page, the page that is displayed when no other page has been selected, and the page that is automatically displayed after a period of inactivity (*LCD Page Timer)* of the module control buttons.

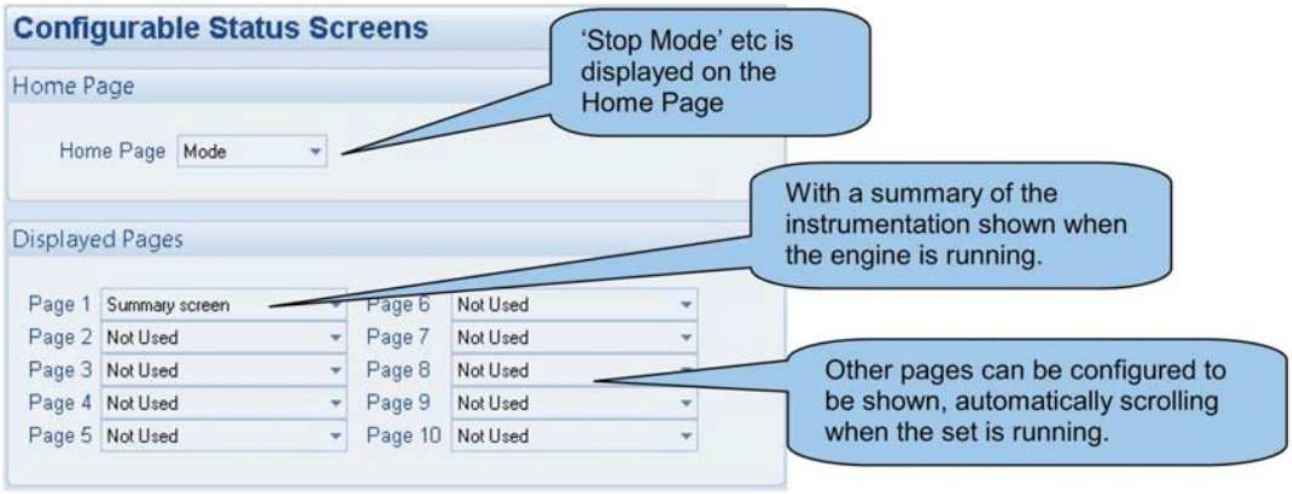
This page is configurable using the DSE Configuration Suite Software.

Factory setting of Status screen showing engine stopped...

...and engine running

The contents of this display may vary depending upon configuration by the generator manufacturer / supplier.

The display above was achieved with the factory settings, shown below in the DSE Configuration suite software:


Configurable Status Screens
'Stop Mode' etc is displayed on the Home Page
Home Page
Home Page Mode
With a summary of the instrumentation shown when the engine is running.
Displayed Pages
Page 1 Summary screen
Page 2 Not Used
Page 3 Not Used
Page 4 Not Used
Page 5 Not Used
Page 6 Not Used
Page 7 Not Used
Page 8 Not Used
Page 9 Not Used
Page 10 Not Used
Other pages can be configured to be shown, automatically scrolling when the set is running.

NOTE:- The following sections detail instrumentation pages, accessible using the scroll left and right buttons, regardless of what pages are configured to be displayed on the 'status' screen.

7.4.2 Engine

Contains instrumentation gathered about the engine itself, some of which may be obtained using the CAN or other electronic engine link.

- Engine Speed
- Oil Pressure
- Coolant Temperature
- Engine Battery Volts
- Run Time
- Oil Temperature*
- Coolant Pressure*
- Inlet Temperature*
- Exhaust Temperature*
- Fuel Temperature*
- Turbo Pressure
- Fuel Pressure*
- Fuel Consumption*
- Fuel Used*
- Fuel Level*
- Auxiliary Sensors (If fitted and configured)
- Engine Maintenance Due (If configured)
- Engine ECU Link*

*When connected to suitably configured and compatible engine ECU. For details of supported engines see 'Electronic Engines and DSE wiring' (DSE Part number 057-004).

Depending upon configuration and instrument function, some of the instrumentation items may include a tick ✓ icon beside them. This denotes a further function is available, detailed in the 'operation' section of this document.

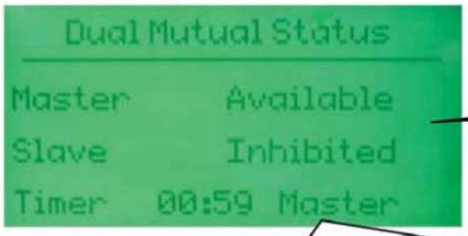
Example:

The tick ✓ icon denotes that manual fuel pump control is enabled in this system.
Press and hold to start the fuel transfer pump, release to stop the pump. This is further detailed in the section entitled 'operation' elsewhere in this document.

7.4.3 Generator

Contains electrical values of the generator (alternator), measured or derived from the module's voltage and current inputs.

- Generator Voltage (ph-N)
- Generator Voltage (ph-ph)
- Generator Frequency
- Generator Current
- Generator Earth Current
- Generator Load (kW)
- Generator Load (kVA)
- Generator Power Factor
- Generator Load (kVAr)
- Generator Load (kWh, kVAh, kVArh)
- Generator Phase Sequence
- Dual Mutual Status



Available : The set is running and available
Inhibited : The set is prevented from running by the 'other' controller

Master : The master set will call for the slave when the timer (hrs:mins) expires.
Slave : The master will call for the slave until the timer (hrs:mins) expires.

7.5 Viewing the Event Log

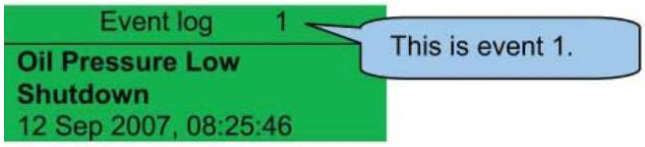
The DSE7000 series modules maintain a log of past alarms and/or selected status changes.
The log size has been increased in the module over past module updates and is always subject to change. At the time of writing, the 7300 series log is capable of storing the last 250 log entries.

Under default factory settings, the event log only includes shutdown and electrical trip alarms logged (The event log does not contain Warning alarms), however this is configurable by the system designer using the DSE Configuration Suite software.

Event Log
Display Options
Module display
Date and time
Engine hours run
Logging Options
Log the following events to the event log
Power up
Mains fail
Mains Return
ECU Shutdown alarms
Shutdown alarms
Electrical trip alarms
Latched warnings
Unlatched warnings
Example showing the possible configuration of the DSE7000 series event log (DSE Configuration Suite Software)
This also shows the factory settings of the module (Only shutdown alarms and the mains status are logged).

Once the log is full, any subsequent shutdown alarms will overwrite the oldest entry in the log.
Hence, the log will always contain the most recent shutdown alarms.
The module logs the alarm, along with the date and time of the event (or engine running hours if configured to do so).
If the module is configured and connected to send SMS text

To view the event log, repeatedly press the next page button until the LCD screen displays the Event log :



Press down to view the next most recent shutdown alarm:

Continuing to press down cycles through the past alarms after which the display shows the most recent alarm and the cycle begins again.

To exit the event log and return to viewing the instruments, press the next page button to select the next instrumentation page.

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7.6 Controls

Stop / Reset This button places the module into its **Stop/Reset** mode. This will clear any alarm conditions for which the triggering criteria have been removed. If the engine is running and the module is in Stop mode, the module will automatically instruct the changeover device to unload the generator *('**Close Generator**' becomes inactive (if used))*. The fuel supply de-energises and the engine comes to a standstill. Should a **remote start signal** be present while operating in this mode, a remote start will not occur.	
Manual This mode allows manual control of the generator functions. Once in **Manual mode** the module will respond to the start button, start the engine, and run off load. If the engine is running off-load in the **Manual mode** and a **remote start signal** becomes present, the module will automatically instruct the changeover device to place the generator on load *('**Close Generator**' becomes active (if used))*. Upon removal of the **remote start signal**, the generator remains on load until either selection of the **'STOP/RESET'** or **'AUTO'** modes. *For further details, please see the more detailed description of 'Manual operation' elsewhere in this manual.*	
Auto This button places the module into its **'Automatic'** mode. This mode allows the module to control the function of the generator automatically. The module will monitor the *remote start* input and mains supply status and once a start request is made, the set will be automatically started and placed on load. Upon removal of the starting signal, the module will automatically transfer the load from the generator and shut the set down observing the *stop delay* timer and *cooling* timer as necessary. The module will then await the next start event. *For further details, please see the more detailed description of 'Auto operation' elsewhere in this manual.*	
5.7.1.1 TEST (DSE7220/DSE7320 ONLY) This button places the module into its **'Test'** mode. This allows an on load test of the generator. Once in **Test mode** the module will respond to the start button, start the engine, and run on load. *For further details, please see the more detailed description of 'Test operation' elsewhere in this manual.*	
5.7.1.2 START This button is only active in STOP/RESET or MANUAL mode. Pressing this button in manual or test mode will start the engine and run off load (manual) or on load (test). Pressing this button in STOP/RESET mode will turn on the CAN engine ECU (when correctly configured and fitted to a compatible engine ECU)	
Mute / Lamp Test This button silences the audible alarm if it is sounding and illuminates all of the LEDs as a lamp test feature/ When correctly configured and fitted to a compatible engine ECU, pressing this button in STOP/RESET mode after pressing the START button (to power the ECU) will cancel any "passive" alarms on the engine ECU.	

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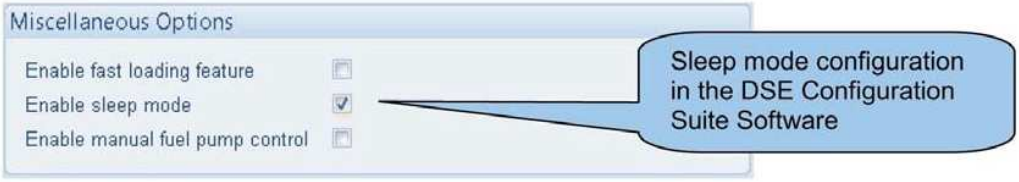
Transfer to generator Allows the operator to transfer the load to the generator (when in Manual mode only)	
Open generator (DSE7210/DSE7310 only) Allows the operator to open the generator (when in Manual mode only)	
Transfer to mains (DSE7220/DSE7320 only) Allows the operator to transfer the load to the mains (when in Manual mode only)	
Menu navigation Used for navigating the instrumentation, event log and configuration screens. For further details, please see the more detailed description of these items elsewhere in this manual.	

When the engine has stopped, it is possible to send configuration files to the module from DSE Configuration Suite PC software and to enter the Front Panel Editor to change parameters.

Any latched alarms that have been cleared will be reset when STOP mode is entered.

The engine will not be started when in STOP mode. If remote start signals are given, the input is ignored until AUTO mode is entered.

When configured to do so, When left in STOP mode for five minutes with no presses of the fascia buttons, the module enters low power mode. To 'wake' the module, press the button or any other fascia control button.


Miscellaneous Options
Enable fast loading feature
Enable sleep mode
Enable manual fuel pump control
Sleep mode configuration in the DSE Configuration Suite Software

7.6.1 ECU Override

NOTE:- ECU Override function is only applicable to the CAN variant of the 6100 series controller.

NOTE:- Depending upon system design, the ECU may be powered or unpowered when the module is in STOP mode. ECU override is only applicable if the ECU is unpowered when in STOP mode.

When the ECU powered down (as is normal when in STOP mode), it is not possible to read the diagnostic trouble codes or instrumentation. Additionally, it is not possible to use the engine manufacturers' configuration tools.

7.7 Automatic Mode

NOTE:- If a digital input configured to *panel lock* is active, changing module modes will not be possible. Viewing the instruments and event logs is NOT affected by panel lock.

Activate auto mode be pressing the pushbutton. An LED indicator beside the button confirms this action.

Auto mode will allow the generator to operate fully automatically, starting and stopping as required with no user intervention.

7.7.1 Waiting in Auto Mode

If a starting request is made, the starting sequence will begin.
Starting requests can be from the following sources:

- Mains supply out of limits (DSE7220/7320 only)
- Activation of an auxiliary input that has been configured to *remote start on load* or *remote start off load.*
- Activation of the inbuilt exercise scheduler.
- Instruction from external remote telemetry devices using the RS232 or RS485 interface (DSE7310/DSE7320 only).

7.7.2 Starting Sequence

To allow for 'false' start requests such as mains brownouts, the *start delay* timer begins. There are individual start delay timers for each of the different start request types.

Should all start requests be removed during the *start delay* timer, the unit will return to a stand-by state.

If a start request is still present at the end of the *start delay* timer, the fuel relay is energised and the engine will be cranked.

NOTE:- If the unit has been configured for CAN, compatible ECU's will receive the start command via CAN.

If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the *crank rest* duration after which the next start attempt begins. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and the display shows ***Fail to Start.***

The starter motor is disengaged when the engine fires. Speed detection is factory configured to be derived from the main alternator output frequency, but can additionally be measured from a Magnetic Pickup mounted on the flywheel (Selected by PC using the 7000 series configuration software).

Additionally, rising oil pressure can be used to disconnect the starter motor (but cannot detect underspeed or overspeed).

NOTE:- If the unit has been configured for CAN, speed sensing is via CAN.

After the starter motor has disengaged, the *Safety On* timer activates, allowing Oil Pressure, High Engine Temperature, Under-speed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

7.8 Manual Mode

NOTE:- If a digital input configured to *panel lock* is active, changing module modes will not be possible. Viewing the instruments and event logs is NOT affected by panel lock.

Activate Manual mode be pressing the pushbutton. An LED indicator beside the button confirms this action.

Manual mode allows the operator to start and stop the set manually, and if required change the state of the load switching devices.

7.8.1 Waiting in Manual Mode

When in manual mode, the set will not start automatically.

To begin the starting sequence, press the button.

7.8.2 Starting Sequence

NOTE:- There is no *start delay* in this mode of operation.

The fuel relay is energised and the engine is cranked.

NOTE:- If the unit has been configured for CAN, compatible ECU's will receive the start command via CAN.

If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the *crank rest* duration after which the next start attempt is made. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and the display shows ***Fail to Start.***

When the engine fires, the starter motor is disengaged. Speed detection is factory configured to be derived from the main alternator output frequency but can additionally be measured from a Magnetic Pickup mounted on the flywheel (Selected by PC using the 7000 series configuration software).

Additionally, rising oil pressure can be used disconnect the starter motor (but cannot detect underspeed or overspeed).

NOTE:- If the unit has been configured for CAN, speed sensing is via CAN.

After the starter motor has disengaged, the *Safety On* timer activates, allowing Oil Pressure, High Engine Temperature, Under-speed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

7.8.3 Engine Running

In manual mode, the load is not transferred to the generator unless a 'loading request' is made. A loading request can come from a number of sources.

- Pressing the *transfer to generator* button
- Mains supply out of limits (DSE7220/DSE7320 only)
- Activation of an auxiliary input that has been configured to *remote start on load*
- Activation of the inbuilt exercise scheduler if configured for 'on load' runs.

NOTE:-The load transfer signal remains inactive until the Oil Pressure has risen. This prevents excessive wear on the engine.

Once the load has been transferred to the generator, it will not be automatically transferred back to the mains supply. To manually transfer the load back to the mains either:

- Press the *transfer to mains* button (DSE7220/DSE7320 only)
- Press the *Open Generator* button (DSE7210/DSE7310 only)
- Press the *auto mode* button to return to automatic mode.

7.8.4 Manual Fuel Pump Control

NOTE:-Manual Fuel Pump Control is only available on suitably configured systems with V3 or higher control modules. Consult your set supplier for further advice.

- Navigate to the instruments page using the buttons and locate FUEL LEVEL. is shown on the module display to indicate that this feature is available.
- Press and hold the button to energise the transfer pump. The pump starts two seconds after the button is pressed.
- Release the button to de-energise the transfer pump.

7.8.5 Manual Speed Control

NOTE:-Manual Speed Control is only available on suitably configured systems with V3 or higher control modules. Consult your set supplier for further advice.

- Navigate to the instruments page using the buttons and locate ENGINE SPEED. is shown on the module display to indicate that this feature is available.
- Press the button to enter edit mode
- Press (up or down) to change the engine speed.
- Press the button again to exit the editor and leave the engine running at the newly selected speed.

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7.8.6 Stopping Sequence

In manual mode the set will continue to run until either :

- The *stop button* is pressed – The set will immediately stop
- The *auto button* is pressed. The set will observe all auto mode start requests and stopping timers before beginning the *Auto mode stopping sequence*.

7.9 Test Mode

NOTE:- Test Mode is only applicable to DSE7220/DSE7320 controllers.

NOTE:- If a digital input configured to *panel lock* is active, changing module modes will not be possible. Viewing the instruments and event logs is NOT affected by panel lock.

Activate test mode be pressing the pushbutton. An LED indicator beside the button confirms this action.

Test mode will start the set and transfer the load to the generator to provide a ***Test on load*** function.

7.9.1 Waiting In Test Mode

When in test mode, the set will not start automatically.

To begin the starting sequence, press the button.

7.9.2 Starting Sequence

The set begins to crank.

NOTE:- If the unit has been configured for CAN, compatible ECU's will receive the start command via CAN.

If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the *crank rest* duration after which the next start attempt is made. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and the display shows ***Fail to Start.***

When the engine fires, the starter motor is disengaged. Speed detection is factory configured to be derived from the main alternator output frequency but can additionally be measured from a Magnetic Pickup mounted on the flywheel (Selected by PC using the 7000 series configuration software).

Additionally, rising oil pressure can be used disconnect the starter motor (but cannot detect underspeed or overspeed).

NOTE:- If the unit has been configured for CAN, speed sensing is via CAN.

After the starter motor has disengaged, the *Safety On* timer activates, allowing Oil Pressure, High Engine Temperature, Under-speed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

7.9.3 Engine Running

Once the engine is running, the *Warm Up* timer, if selected, begins, allowing the engine to stabilise before accepting the load.

Load will be automatically transferred from the mains supply to the generator.

⚠NOTE:-The load transfer signal remains inactive until the Oil Pressure has risen. This prevents excessive wear on the engine.

In test mode, the set will continue to run *on load* until either:

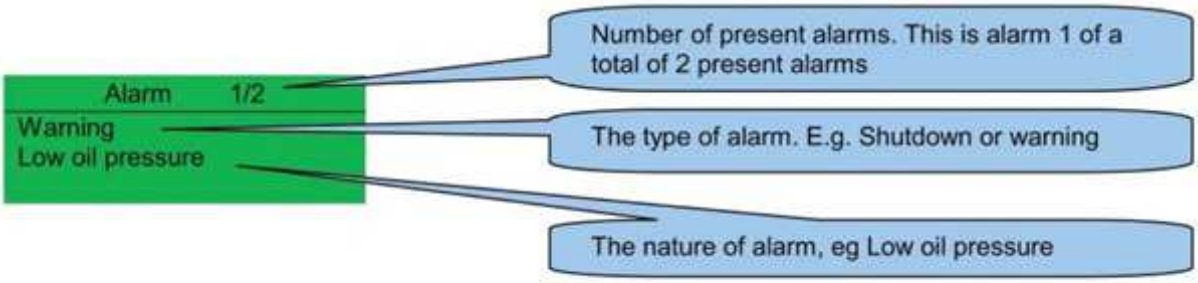
- The *stop button* is pressed – The set will immediately stop
- The *auto button* is pressed. The set will observe all auto mode start requests and stopping timers before beginning the *Auto mode stopping sequence*.

7.10 Protections

When an alarm is present, the Audible Alarm will sound and the Common alarm LED if configured will illuminate.

The audible alarm can be silenced by pressing the *Mute button*

The LCD display will jump from the 'Information page' to display the Alarm Page


Alarm 1/2
Warning
Low oil pressure
Number of present alarms. This is alarm 1 of a total of 2 present alarms
The type of alarm. E.g. Shutdown or warning
The nature of alarm, eg Low oil pressure

The LCD will display multiple alarms E.g. "High Engine Temperature shutdown", "Emergency Stop" and "Low Coolant Warning". These will automatically scroll in the order that they occurred.

In the event of a warning alarm, the LCD will display the appropriate text. If a shutdown then occurs, the module will again display the appropriate text.
Example:-

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7.11 Protections Disabled

User configuration is possible to prevent Shutdown/Electrical Trip alarms from stopping the engine. Under such conditions, *Protective Disabled* will appear on the module display to inform the operator of this status.

This feature is provided to assist the system designer in meeting specifications for “Warning only”, “Protections Disabled”, “Run to Destruction”, “War mode” or other similar wording.

When configuring this feature in the PC software, the system designer chooses to make the feature either permanently active, or only active upon operation of an external switch. The system designer provides this switch (not DSE) so its location will vary depending upon manufacturer, however, it normally takes the form of a key operated switch to prevent inadvertent activation. Depending upon configuration, a warning alarm may be generated when the switch is operated.

The feature is configurable in the PC configuration software for the module. Writing a configuration to the controller that has ‘Protections Disabled’ configured, results in a warning message appearing on the PC screen for the user to acknowledge before the controller’s configuration is changed. This prevents inadvertent activation of the feature.

7.11.1 Indications/Warning Alarms

Under Indication or Warning alarms:

- The module operations is unaffected by the Protections Disabled feature. See sections entitled Indications and Warnings elsewhere in this document.

7.11.2 Shutdown/Electrical Trip Alarms

NOTE:- The EMERGENCY STOP input and shutdown alarm continues to operate even when *Protections Disabled* has been activated.

Under Shutdown or Electrical Trip alarm conditions (excluding Emergency Stop):

- The alarm is displayed on the screen as detailed in the section entitled *Shutdown alarms* elsewhere in this document.
- The set continues to run.
- The load switch maintains its current position (it is not opened if already closed)
- ***Shutdown Blocked*** also appears on the LCD screen to inform the operator that the Protections Disabled feature has blocked the shutdown of the engine under the normally critical fault.
- The ‘shutdown’ alarm is logged by the controllers *Event Log* (if configured to log shutdown alarms) and logs that the Shutdown was prevented.

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7.12 Indications

Indications are non-critical and often status conditions. They do not appear on the LCD of the module as a text message. However an output or LED indicator can be configured to draw the operators attention to the event.

Example

- Input configured for indication.
- The LCD text will not appear on the module display but can be added in the configuration to remind the system designer what the input is used for.
- As the input is configured to *Indication* there is no alarm generated.

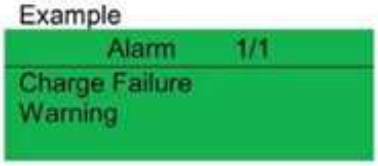
- LED Indicator to make LED1 illuminate when Digital Input A is active.
- The Insert Card Text allows the system designer to print an insert card detailing the LED function.

- Sample showing operation of the LED.

7.13 Warnings

Warnings are non-critical alarm conditions and do not affect the operation of the generator system, the serve to draw the operators attention to an undesirable condition.

Example



In the event of an alarm the LCD will jump to the alarms page, and scroll through all active warnings and shutdowns.

By default, warning alarms are self-resetting when the fault condition is removed. However enabling 'all warnings are latched' will cause warning alarms to latch until reset manually. This is enabled using the 7000 series configuration suite in conjunction with a compatible PC.

Display	Reason
CHARGE FAILURE	The auxiliary charge alternator voltage is low as measured from the W/L terminal.
BATTERY UNDER VOLTAGE	The DC supply has fallen below the low volts setting level for the duration of the low battery volts timer
BATTERY OVER VOLTAGE	The DC supply has risen above the high volts setting level for the duration of the high battery volts timer
FAIL TO STOP	The module has detected a condition that indicates that the engine is running when it has been instructed to stop. **NOTE:- 'Fail to Stop' could indicate a faulty oil pressure sensor or switch - If the engine is at rest check oil sensor wiring and configuration.**
FUEL USAGE	Indicates the amount of fuel measured by the fuel level sensor is in excess of the *Fuel Usage* alarm settings. This often indicates a fuel leak or potential fuel theft.
AUXILIARY INPUTS	Auxiliary inputs can be user configured and will display the message as written by the user.
LOW FUEL LEVEL	The level detected by the fuel level sensor is below the low fuel level setting.
CAN ECU ERROR	The engine ECU has detected a warning alarm and has informed the DSE module of this situation. The exact error is also indicated on the module's display.
kW OVERLOAD	The measured Total kW is above the setting of the kW overload warning alarm
EARTH FAULT (DSE7300 series V2.0 or above only)	The measured Earth Fault Current has been in excess of the earth fault trip and has surpassed the IDMT curve of the Earth Fault alarm.
NEGATIVE PHASE SEQUENCE (DSE7000 series V2.0 or above only)	Indicates 'out of balance' current loading of the generator. Sometimes also called Negative Sequence Current or Symmetry Fault
MAINTENANCE DUE (DSE7000 series V2.1 or above only)	Indicates that the maintenance alarm has triggered. A visit is required by the Generator service company.
LOADING VOLTAGE NOT REACHED	Indicates that the generator voltage is not above the configured *loading voltage*. The generator will not take load when the alarm is present after the safety timer.
LOADING FREQUENCY NOT REACHED	Indicates that the generator frequency is not above the configured *loading frequency*. The generator will not take load when the alarm is present after the safety timer.

PROTECTIONS DISABLED	Shutdown and electrical trip alarms can be disabled by user configuration. In this case, Protections Disabled will appear on the module display; The alarm text will be displayed but the engine will continue to run. This is 'logged' by the module to allow DSE Technical Staff to check if the protections have been disabled on the module at any time. This feature is available from V4 onwards.
LOW OIL PRESSURE	The module detects that the engine oil pressure has fallen below the low oil pressure pre-alarm setting level after the *Safety On* timer has expired.
ENGINE HIGH TEMPERATURE	The module detects that the engine coolant temperature has exceeded the high engine temperature pre-alarm setting level after the *Safety On* timer has expired.
ENGINE LOW TEMPERATURE	The module detects that the engine coolant temperature has fallen below the high engine temperature pre-alarm setting level.
OVERSPEED	The engine speed has risen above the overspeed pre alarm setting
UNDERSPEED	The engine speed has fallen below the underspeed pre alarm setting
GENERATOR OVER FREQUENCY	The generator output frequency has risen above the pre-set pre-alarm setting.
GENERATOR UNDER FREQUENCY	The generator output frequency has fallen below the pre-set pre-alarm setting after the *Safety On* timer has expired.
GENERATOR OVER VOLTAGE	The generator output voltage has risen above the pre-set pre-alarm setting.
GENERATOR UNDER VOLTAGE	The generator output voltage has fallen below the pre-set pre-alarm setting after the *Safety On* timer has expired.
ECU WARNING	The engine ECU has detected a warning alarm and has informed the DSE module of this situation. The exact error is also indicated on the module's display.

If the module is configured for **CAN** and receives an 'error' message from the engine control unit, "CAN ECU Warning" is shown on the module's display and a warning alarm is generated.

7.14 High Current Warning Alarm

GENERATOR HIGH CURRENT, if the module detects a generator output current in excess of the pre-set trip a warning alarm initiate. The module shows Alarm Warning High Current. If this high current condition continues for an excess period, then the alarm escalates to a shutdown condition. For further details of the high current alarm, please see High Current Shutdown Alarm.

By default, High Current Warning Alarm is self-resetting when the overcurrent condition is removed. However, enabling 'all warnings are latched' will cause the alarm to latch until reset manually. This is enabled using the 7000 series configuration suite in conjunction with a compatible PC.

7.15 Shutdowns

NOTE:- Shutdown and Electrical Trip alarms can be disabled by user configuration. See the section entitled *Protections Disabled* elsewhere in this document.

Shutdowns are latching alarms and stop the Generator. Clear the alarm and remove the fault then press Stop/Reset to reset the module.

Example

Alarm 1/1
Oil Pressure Low Shutdown

NOTE:- The alarm condition must be rectified before a reset will take place. If the alarm condition remains, it will not be possible to reset the unit (The exception to this is the Low Oil Pressure alarm and similar 'active from safety on' alarms, as the oil pressure will be low with the engine at rest).

Display	Reason
EARTH FAULT (DSE7300 series V2.0 or above only)	The measured Earth Fault Current has been in excess of the earth fault trip and has surpassed the IDMT curve of the Earth Fault alarm.
FAIL TO START	The engine has not fired after the preset number of start attempts
EMERGENCY STOP	The emergency stop button has been depressed. This a failsafe (normally closed to battery positive) input and will immediately stop the set should the signal be removed. Removal of the battery positive supply from the emergency stop input will also remove DC supply from the Fuel and Start outputs of the controller. **NOTE:- The Emergency Stop Positive signal must be present otherwise the unit will shutdown.**
LOW OIL PRESSURE	The engine oil pressure has fallen below the low oil pressure trip setting level after the *Safety On* timer has expired.
ENGINE HIGH TEMPERATURE	The engine coolant temperature has exceeded the high engine temperature trip setting level after the *Safety On* timer has expired.
FUEL USAGE	Indicates the amount of fuel measured by the fuel level sensor is in excess of the *Fuel Usage* alarm settings. This often indicates a fuel leak or potential fuel theft.
PHASE ROTATION (DSE7000 series V2.0 or above only)	The phase rotation is measured as being different to the configured direction.
OVERSPEED	The engine speed has exceeded the pre-set trip **NOTE:-During the start-up sequence, the overspeed trip logic can be configured to allow an extra trip level margin. This is used to prevent nuisance tripping on start-up - Refer to the 7000 series configuration software manual under heading 'Overspeed Overshoot' for details.**
UNDERSPEED	The engine speed has fallen below the pre-set trip after the ***Safety On*** timer has expired.

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Display	Reason
GENERATOR OVER FREQUENCY	The generator output frequency has risen above the preset level
GENERATOR UNDER FREQUENCY	The generator output frequency has fallen below the preset level
GENERATOR OVER VOLTAGE	The generator output voltage has risen above the preset level
GENERATOR UNDER VOLTAGE	The generator output voltage has fallen below the preset level
OIL PRESSURE SENSOR OPEN CIRCUIT	The oil pressure sensor is detected as not being present (open circuit)
AUXILIARY INPUTS	An active auxiliary input configured as a shutdown will cause the engine to shut down. The display shows the text as configured by the user.
LOSS OF SPEED SIGNAL	The speed signal from the magnetic pickup is not being received by the DSE controller.
ECU DATA FAIL	The module is configured for CAN operation and does not detect data on the engine Can datalink, the engine shuts down.
ECU SHUTDOWN	The engine ECU has detected a shutdown alarm and has informed the DSE module of this situation. The exact error is also indicated on the module's display.
kW OVERLOAD	The measured Total kW is above the setting of the kW overload shutdown alarm
NEGATIVE PHASE SEQUENCE (DSE7000 series V2.0 or above only)	Indicates 'out of balance' current loading of the generator. Sometimes also called Negative Sequence Current or Symmetry Fault
MAINTENANCE DUE (DSE7000 series V2.1 or above only)	Indicates that the maintenance alarm has triggered. A visit is required by the Generator service company.
GENERATOR HIGH CURRENT	A High Current condition has continued for an excess period, then the alarm escalates to either a shutdown or electrical trip condition (depending upon module configuration). For further details of the high current alarm, please see High Current Shutdown / Electrical Trip Alarm.
LOADING VOLTAGE NOT REACHED	Indicates that the generator voltage is not above the configured *loading voltage* after the safety timer. The generator will shutdown.
LOADING FREQUENCY NOT REACHED	Indicates that the generator frequency is not above the configured *loading frequency* after the safety timer. The generator will shutdown.
PROTECTIONS DISABLED	Shutdown and electrical trip alarms can be disabled by user configuration. In this case, Protections Disabled will appear on the module display; The alarm text will be displayed but the engine will continue to run. This is 'logged' by the module to allow DSE Technical Staff to check if the protections have been disabled on the module at any time. This feature is available from V4 onwards.

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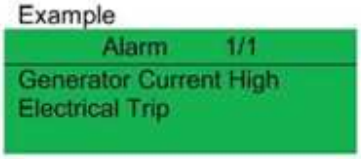
7.16 Electrical Trips

NOTE:- Shutdown and Electrical Trip alarms can be disabled by user configuration. See the section entitled *Protections Disabled* elsewhere in this document.

Electrical trips are latching and stop the Generator but in a controlled manner. On initiation of the electrical trip condition the module will de-energise the **'Close Generator'** Output to remove the load from the generator. Once this has occurred the module will start the Cooling timer and allow the engine to cool off-load before shutting down the engine. The alarm must be accepted and cleared, and the fault removed to reset the module.

Example



Electrical trips are latching alarms and stop the Generator. Remove the fault then press Stop/Reset to reset the module.

Display	Reason
GENERATOR HIGH CURRENT	If a generator output in excess of the high current alarm point, a warning alarm occurs. If this high current condition continues for an excess period, then the alarm escalates to either a shutdown or electrical trip condition (depending upon module configuration). For further details of the high current alarm, please see High Current Shutdown / Electrical Trip Alarm.
AUXILIARY INPUTS	If an auxiliary input configured as an electrical trip is active, the appropriate message will be displayed as configured by the user.
kW OVERLOAD	The measured Total kW is above the setting of the kW overload Electrical Trip alarm
EARTH FAULT (DSE7300 series V2.0 or above only)	The measured Earth Current is above the setting of the Earth fault alarm.
NEGATIVE PHASE SEQUENCE (DSE7000 series V2.0 or above only)	Indicates 'out of balance' current loading of the generator. Sometimes also called Negative Sequence Current or Symmetry Fault
FUEL USAGE	Indicates the amount of fuel used is in excess of the *Fuel Usage* alarm settings. This often indicates a fuel leak or potential fuel theft.
LOADING VOLTAGE NOT REACHED	Indicates that the generator voltage is not above the configured loading voltage after the safety timer. The generator will shutdown.
LOADING FREQUENCY NOT REACHED	Indicates that the generator frequency is not above the configured loading frequency after the safety timer. The generator will shutdown.
PROTECTIONS DISABLED	Shutdown and electrical trip alarms can be disabled by user configuration. In this case, Protections Disabled will appear on the module display; The alarm text will be displayed but the engine will continue to run. This is 'logged' by the module to allow DSE Technical Staff to check if the protections have been disabled on the module at any time. This feature is available from V4 onwards.
GENERATOR UNDER FREQUENCY	The generator output frequency has fallen below the preset level
GENERATOR UNDER VOLTAGE	The generator output voltage has fallen below the preset level
UNDERSPEED	The engine speed has fallen below the underspeed setting

7.17 High Current Shutdown/Electrical Trip Alarm

The overcurrent alarm combines a simple warning trip level with a fully functioning IDMT curve for thermal protection.

7.17.1 Immediate Warning

If the *Immediate Warning* is enabled, the DSE7000 Series controller generates a *warning alarm* as soon as the *Trip* level is reached. The alarm automatically resets once the generator loading current falls below the *Trip* level (unless *All Warnings are latched* is enabled). For further advice, consult your generator supplier.

7.17.2 IDMT Alarm

If the *IDMT Alarm* is enabled, the DSE7000 Series controller begins following the IDMT 'curve' when the *trip* level is passed.

If the *Trip* is surpassed for an excess amount of time the *IDMT Alarm* triggers (*Shutdown* or *Electric trip* as selected in *Action*).

High current shutdown is a latching alarm and stops the Generator.

Remove the fault then press Stop/Reset to reset the module.

High current electrical trip is a latching alarm and removes the generator from the load, before stopping the Generator after the off load Cooling timer.

Remove the fault then press Stop/Reset to reset the module.

The higher the overload, the faster the trip. The speed of the trip is dependent upon the fixed formula :

$$T = t / ((I_A / I_T) - 1)^2$$

Where: T is the tripping time in seconds
I_A is the actual current of the most highly loaded line (L1 or L2 or L3)
I_T is the delayed over-current trip point
t is the time multiplier setting and also represents the tripping time in seconds at twice full load (when $I_A / I_T = 2$).

Factory settings for the *IDMT Alarm* when used on a brushless alternator are as follows (screen capture from the DSE Configuration Suite PC software :

These settings provide for normal running of the generator up to 100% full load. If full load is surpassed, the *Immediate Warning* alarm is triggered, the set continues to run.
The effect of an overload on the generator is that the alternator windings begin to overheat, the aim of the *IDMT alarm* is to prevent the windings being overload (heated) too much. The amount of time that the set can be safely overloaded is governed by how high the overload condition is.

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7.18 ROCOF/Vector Shift

When configured to run in parallel with the mains (utility) supply, the module monitors for ROCOF / Vector shift trips according to the module's configuration settings. This is included within the module and will detect failure of the mains supply during parallel operation with the generator.

NOTE:- This protection operates only when in parallel with the mains supply and is disabled at all other times.

Should either of these alarms operate, the module will perform a controlled shutdown (electrical trip) of the generator. This operation must be manually reset :

1) Press O button. The engine will stop if it is still running and the alarm is cleared.
2) Activate digital input configured to "Clear ROCOF/Vector shift" if this has been provided.
3) Press and button together and hold for 5 seconds. The ROCOF/Vector shift instrument is displayed and all 'peak hold' values are reset, clearing the ROCOF/Vector shift alarm.

For details on activating and configuring the ROCOF/Vector shift protection, you are referred to the 8600 configuration software manual.

7.19 Maintenance Alarm

Depending upon module configuration one or more levels of maintenance alarm may occur based upon a configurable schedule.
There are three maintenance alarms in the DSE7200/DSE7300 series V3 and above, and one level of maintenance alarm in prior versions.

Example 1

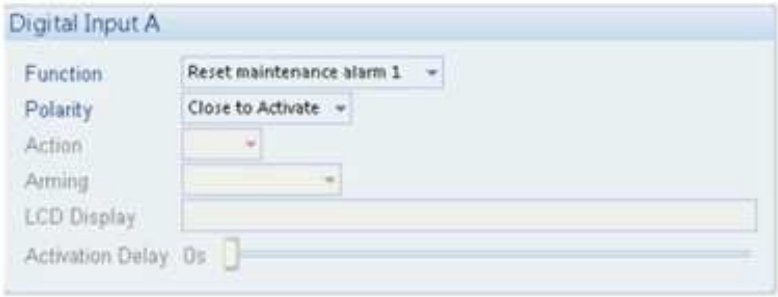
Screen capture from DSE Configuration Suite Software showing the configuration of Maintenance Alarm 1 and Maintenance Alarm 2.

When activated, the maintenance alarm can be either a **warning** (set continues to run) or **shutdown** (running the set is not possible).
Resetting the maintenance alarm is normally actioned by the site service engineer after performing the required maintenance.
The method of reset is either by:

- Activating a input that has been configured to maintenance x reset, where x is the number of the maintenance alarm (1 to 3).
- Pressing the maintenance reset button in the DSE Configuration Suite, Maintenance section.

Example 2

Screen capture from DSE Configuration Suite Software showing the configuration of a digital input for Reset Maintenance Alarm 1.



Example 3

Screen capture from DSE Configuration Suite Software showing the Maintenance Alarm Reset 'button' in the DSE Configuration Suite SCADA | MAINTENANCE section.

7.20 Scheduler

DSE7000 Series contains an inbuilt exercise run scheduler, capable of automatically starting and stopping the set. Up to 16 scheduled start/stop sequences can be configured to repeat on a 7-day or 28-day cycle. Scheduled runs may be on load or off load depending upon module configuration.

Example

Screen capture from DSE Configuration Suite Software showing the configuration of the Exercise Scheduler.

In this example the set will start at 09:00 on Monday and run for 5 hours, then start at 13:30 on Tuesday and run for 30 minutes.

7.20.1 Stop Mode

- Scheduled runs will not occur when the module is in **STOP/RESET** mode.

7.20.2 Manual Mode

- Scheduled runs will not occur when the module is in **MANUAL** mode.
- Activation of a Scheduled Run 'On Load' when the module is operating OFF LOAD in Manual mode will have no effect, the set continues to run OFF LOAD.

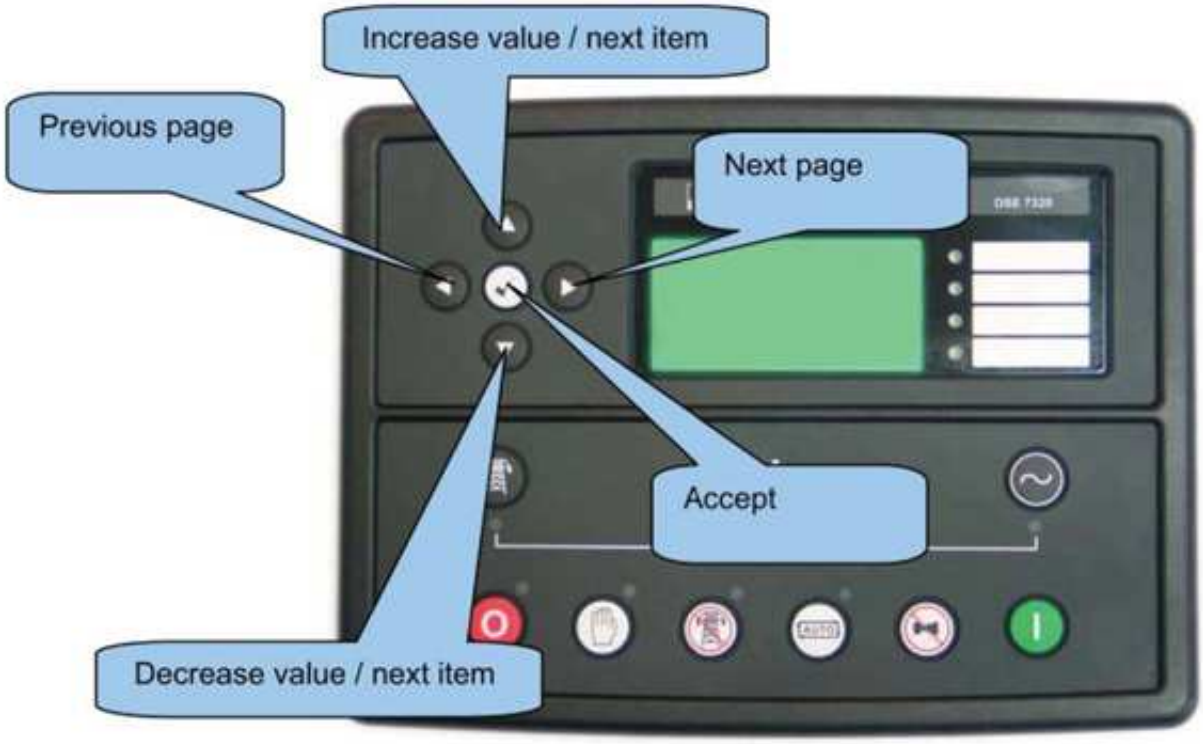
7.20.3 Auto Mode

- Scheduled runs will operate ONLY if the module is in AUTO mode with no Shutdown or Electrical Trip alarm present.
- If the module is in STOP or MANUAL mode when a scheduled run begins, the engine will not be started. However, if the module is moved into AUTO mode during a scheduled run, the engine will be called to start.
- Depending upon configuration by the system designer, an external input can be used to inhibit a scheduled run.
- If the engine is running OFF LOAD in AUTO mode and a scheduled run configured to 'On Load' begins, the set is placed ON LOAD for the duration of the Schedule.

7.21 Front Panel Configuration

This configuration mode allows the operator limited customising of the way the module operates.

Use the module's navigation buttons to traverse the menu and make value changes to the parameters:



7.22 Accessing the Main Front Panel Configuration Editor

Ensure the engine is at rest and the module is in STOP mode by pressing the Stop/Reset button.

Press the Stop/Reset and Info buttons simultaneously.
If a module security PIN has been set, the PIN number request is then shown :

Press , the first '#' changes to '0'. Press (up or down) to adjust it to the correct value.

Press (right) when the first digit is correctly entered. The digit you have just entered will now show '#' for security.

Repeat this process for the other digits of the PIN number. You can press (left) if you need to move back to adjust one of the previous digits.

When is pressed after editing the final PIN digit, the PIN is checked for validity. If the number is not correct, you must re-enter the PIN.

If the PIN has been successfully entered (or the module PIN has not been enabled), the editor is displayed :

NOTE: The PIN number is not set by DSE when the module leaves the factory. If the module has a PIN code set, this has been affected by your generator supplier who should be contacted if you require the code. If the code has been 'lost' or 'forgotten', the module must be returned to the DSE factory to have the module's code removed. A charge will be made for this procedure.
NB - This procedure cannot be performed away from the DSE factory.

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7.22.1 Editing a Parameter

Enter the editor as described above.

Press the (left) or (right) buttons to cycle to the section you wish to view/change.

Press the (up or down) buttons to select the parameter you wish to view/change within the currently selected section.

To edit the parameter, press ✓ to enter edit mode. The parameter begins to flash to indicate that you are editing the value.

Press the (up or down) buttons to change the parameter to the required value.

Press ✓ to save the value. The parameter ceases flashing to indicate that it has been saved.

To exit the editor at any time, press and hold the ✓ button.

⚠NOTE: - The editor automatically exits after 5 minutes of inactivity to ensure security.

⚠NOTE: - The PIN number is automatically reset when the editor is exited (manually or automatically) to ensure security.

⚠ NOTE: - More comprehensive module configuration is possible using the 7xxx series PC configuration software. Please contact us for further details.

7.22.2 Adjustable Parameters

Front Panel Configuration Editor

= Only available on DSE7220 / DSE7320 AMF Modules

Section	Parameter as shown on display	Factory Settings
DISPLAY	Contrast	53%
	Language	English
	LCD Page Timer	5m
	Auto Scroll Delay	2s
	Current Date and time	hh:mm
EDITOR	Alt Config	Default Config
ENGINE	Oil Pressure Low Shutdown	1.03bar
	Oil Pressure Low Pre Alarm	1.17bar
	Coolant Temperature Low Warning	70°C
	Coolant Temperature High Pre Alarm	90°C
	Coolant Temperature High Shutdown	95°C
	Remote Start Delay Off Load	5s
	Remote Start Delay On Load	5s
	Mains Fail Start Delay	5s
	Telemetry Start Delay	5s
	Start Delay Timer	5s
	Pre Heat Timer	0s
	Crank Duration Timer	10s
	Crank Rest Timer	10s
	Safety On Delay	10s
	Smoke Limiting	0s
	Smoke Limiting off	0s
	Warm Up Timer	0s
	Cool Down Timer	1m
	Engine Under Speed Shutdown	Inactive
	Engine Under Speed Shutdown	1200RPM
	Engine Under Speed Warning	Inactive
	Engine Under Speed Warning	1350RPM
	Engine Over Speed Warning	Inactive
	Engine Over Speed Warning	1650RPM
	Engine Over Speed Shutdown	1710RPM
	Engine Speed Overshoot Delay	2s
	Engine Speed Overshoot	0s
	Fail To Stop Delay	30s
	Battery Under Voltage Warning	Active
	Battery Under voltage Warning Delay	1m
	Battery Under Voltage	10V
	Battery Over Voltage Warning	Active
	Battery Over Voltage warning Delay	1m
	Battery Over Voltage Warning	30V
	Charge Alternator Failure Warning	Active
	Charge Alternator Failure Warning	6V
	Charge Alternator Warning Delay	5s
	Charge Alternator Failure Shutdown	Active
	Charge Alternator Failure Shutdown	4.0V
	Charge Alternator Shutdown Delay	5s
	Droop control	Inactive
	Droop control	4% (Compatible engine ECUs only)
	Fuel Usage Alarm (Running Rate)	0%-100%
	Fuel Usage Alarm (Stopped Rate)	0%-100%
GENERATOR	Generator Under Voltage Shutdown	184V
	Generator Under Voltage Pre Alarm	196V
	Generator Voltage Nominal	230V
	Generator Over Voltage Pre Alarm	265V
	Generator Over Voltage Shutdown	277V
	Generator Under Frequency Shutdown	40Hz
	Generator Under Frequency Pre Alarm	42Hz
	Generator Frequency Nominal	50Hz
	Generator Over Frequency Pre Alarm	55Hz
	Generator Over Frequency Shutdown	57Hz
	Full Load Rating	500A
	Kw Overload Trip	100%
	Delayed Over Current	Active
	Delayed Over Current	100%
	AC System	3 Phase, 4 Wire
	CT Primary	600A
	CT Secondary	5A
	Earth CT Primary	500A
	Earth Fault Trip	Inactive
	Earth Fault Trip	10%
	Generator transient delay	0s

Front Panel Configuration Editor (continued)

Section	Parameter as shown on display	Factory Settings
MAINS	Mains Under Voltage Trip	184V
	Mains Over Voltage Trip	276V
	Mains Under Frequency Trip	45Hz
	Mains Over Frequency Trip	55Hz
	Mains Transient Delay	2s
	Return Delay	30s
	Mains Transfer Time	0.7s
TIMERS	LCD Page Timer	5m
	Auto Scroll Delay	3s
	Pre Heat Timer	0s
	Crank Duration Timer	0s
	Crank Rest Timer	10s
	Safety On Delay	10s
	Smoke Limiting	10s
	Smoke Limiting Off	0s
	Warm Up Timer	0s
	Cool Down Timer	0s
	Speed Overshoot Delay	1m
	Fail To Stop Delay	2s
	Battery voltage Low Warning Delay	30s
	Battery Voltage High Warning Delay	1m
	Return Delay	1m
	Generator Transient Delay	30s
	Mains Transient Delay	0s
	Mains Transfer Time	2s
	Schedule	0.7s
SCHEDULE	Schedule On Load	Active, Inactive
	Schedule Period	Active, Inactive (only available when Scheduler is active)
	Schedule time and Date Selection (1-16)	Weekly, Monthly, (only available when Scheduler is active
	Schedule time and Date Selection (1-16)	Press ✓ to begin editing then ▲ or ▼ to select the different parameters in the scheduler.

7.23 Accessing the 'Running' Configuration Editor

The 'running' editor can be entered while the engine is running. All protections remain active if the engine is running while the running editor is entered.

Press and hold the ✓ button to enter the running editor.

7.23.1 Editing A Parameter

Enter the editor as described above.

Press the (left) or (right) buttons to cycle to the section you wish to view/change.

Press the (up or down) buttons to select the parameter you wish to view/change within the currently selected section.

To edit the parameter, press ✓ to enter edit mode. The parameter begins to flash to indicate that you are editing the value.

Press the (up or down) buttons to change the parameter to the required value.

Press ✓ to save the value. The parameter ceases flashing to indicate that it has been saved.

To exit the editor at any time, press and hold the ✓ button.

7.23.2 Adjustable Parameters (Running Editor)

Running Editor (Factory default settings are shown in bold italicised text)

Section	Parameter as shown on display	Factory Setting
DISPLAY	Contrast	50%
	Language	English
	Engine Speed (if 'manual speed control' is enabled)	
	Fuel Pump Control (if 'manual fuel pump control' is enabled)	

7.24 Commissioning

7.24.1 Pre-Commissioning

Before the system is started, it is recommended that the following checks are made:-

10.1. The unit is adequately cooled and all the wiring to the module is of a standard and rating compatible with the system. Check all mechanical parts are fitted correctly and that all electrical connections (including earths) are sound.

10.2. The unit **DC** supply is fused and connected to the battery and that it is of the correct polarity.

10.3. The Emergency Stop input is wired to an external **normally closed** switch connected to **DC positive.**

NOTE:- If Emergency Stop feature is not required, link this input to the DC Positive. The module will not operate unless either the Emergency Stop is fitted correctly OR terminal 3 is connected to DC positive.

10.4. To check the start cycle operation, take appropriate measures to prevent the engine from starting (disable the operation of the fuel solenoid). After a visual inspection to ensure it is safe to proceed, connect the battery supply. Select **"MANUAL"** and then press **"START"** the unit start sequence will commence.

10.5. The starter will engage and operate for the pre-set crank period. After the starter motor has attempted to start the engine for the pre-set number of attempts, the LCD will display 'Failed *to start*. Select the **STOP/RESET** position to reset the unit.

10.6. Restore the engine to operational status (reconnect the fuel solenoid). Select **"MANUAL"** and then press **"START"**. This time the engine should start and the starter motor should disengage automatically. If not then check that the engine is fully operational (fuel available, etc.) and that the fuel solenoid is operating. The engine should now run up to operating speed. If not, and an alarm is present, check the alarm condition for validity, then check input wiring. The engine should continue to run for an indefinite period. It will be possible at this time to view the engine and alternator parameters - refer to the 'Description of Controls' section of this manual.

10.7. Select **"AUTO"** on the front panel, the engine will run for the pre-set cooling down period, then stop. The generator should stay in the standby mode. If not check that there is not a signal present on the **Remote start** input.

10.8. Initiate an automatic start by supplying the remote start signal (if configured). The start sequence will commence and the engine will run up to operational speed. Once the generator is available a load transfer will take place (if configured), the Generator will accept the load. If not, check the wiring to the Generator Contactor Coil *(if used)*. Check the Warming timer has timed out.

10.9. Remove the remote start signal. The return sequence will begin. After the pre-set time, the generator is unloaded. The generator will then run for the pre-set cooling down period, then shutdown into its standby mode.

10.10. Set the modules internal clock/calendar to ensure correct operation of the scheduler and event logging functions. For details of this procedure see section entitled *Front Panel Configuration – Editing the date and time.*

10.11. If, despite repeated checking of the connections between the **7000** series controller and the customer's system, satisfactory operation cannot be achieved, then the customer is requested to contact the factory for further advice on:-

7.25 Fault Finding

SYMPTOM	POSSIBLE REMEDY
Unit is inoperative Read/Write configuration does not operate	Check the battery and wiring to the unit. Check the DC supply. Check the DC fuse.
Unit shuts down	Check DC supply voltage is not above 35 Volts or below 9 Volts Check the operating temperature is not above 70℃. Check the DC fuse.
Unit locks out on Emergency Stop	If no Emergency Stop Switch is fitted, ensure that a DC positive signal is connected to the Emergency Stop input. Check emergency stop switch is functioning correctly. Check Wiring is not open circuit.
Intermittent Magnetic Pick-up sensor fault	Ensure that Magnetic pick-up screen only connects to earth at one end, if connected at both ends, this enables the screen to act as an aerial and will pick up random voltages. Check pickup is correct distance from the flywheel teeth.
Low oil Pressure fault operates after engine has fired	Check engine oil pressure. Check oil pressure switch/sensor and wiring. Check configured polarity (if applicable) is correct (i.e. Normally Open or Normally Closed) or that sensor is compatible with the 73x0 Module and is correctly configured.
High engine temperature fault operates after engine has fired.	Check engine temperature. Check switch/sensor and wiring. Check configured polarity (if applicable) is correct (i.e. Normally Open or Normally Closed) or that sensor is compatible with the 7000 series module.
Shutdown fault operates	Check relevant switch and wiring of fault indicated on LCD display. Check configuration of input.
Warning fault operates	Check relevant switch and wiring of fault indicated on LCD display. Check configuration of input.
Fail to Start is activated after pre-set number of attempts to start	Check wiring of fuel solenoid. Check fuel. Check battery supply. Check battery supply is present on the Fuel output of the module. Check the speed-sensing signal is present on the 7000 series module's inputs. Refer to engine manual.
Continuous starting of generator when in **AUTO**	Check that there is no signal present on the "Remote Start" input. Check configured polarity is correct. Check the mains supply is available and within configured limits (DSE7220/DSE7320 only)
Generator fails to start on receipt of Remote Start signal.	Check Start Delay timer has timed out. Check signal is on "Remote Start" input. Confirm correct configuration of input is configured to be used as "Remote Start". Check that the oil pressure switch or sensor is indicating low oil pressure to the controller. Depending upon configuration, then set will not start if oil pressure is not low.
Pre-heat inoperative	Check wiring to engine heater plugs. Check battery supply. Check battery supply is present on the Pre-heat output of module. Check pre-heat configuration is correct.
Starter motor inoperative	Check wiring to starter solenoid. Check battery supply. Check battery supply is present on the Starter output of module. Ensure that the Emergency Stop input is at Positive. Ensure oil pressure switch or sensor is indicating the "low oil pressure" state to the 7300 series controller.
Engine runs but generator will not take load	Check Warm up timer has timed out. Ensure generator load inhibit signal is not present on the module inputs. Check connections to the switching device. Note that the set will not take load in manual mode unless there is an active remote start on load signal.

SYMPTOM	POSSIBLE REMEDY
Incorrect reading on Engine gauges Fail to stop alarm when engine is at rest	Check engine is operating correctly. Check sensor and wiring paying particular attention to the wiring to terminal 47 (refer to appendix). Check that sensor is compatible with the 7000 series module and that the module configuration is suited to the sensor.
Module appears to 'revert' to an earlier configuration	When editing a configuration using the PC software it is vital that the configuration is first 'read' from the controller before editing it. This edited configuration must then be "written" back to the controller for the changes to take effect. When editing a configuration using the fascia editor, be sure to press the Accept button to save the change before moving to another item or exiting the fascia editor
Set will not take load	Ensure the generator available LED is lit Check that the output configuration is correct to drive the load switch device and that all connections are correct. Remember that the set will not take load in manual mode unless a remote start on load input is present or the close generator button is pressed.
Inaccurate generator measurements on controller display	Check that the CT primary, CT secondary and VT ratio settings are correct for the application. Check that the CTs are wired correctly with regards to the direction of current flow (p1,p2 and s1,s2) and additionally ensure that CTs are connected to the correct phase (errors will occur if CT1 is connected to phase 2). Remember to consider the power factor. Ie (kW = kVA x powerfactor) The 7000 series controller is true RMS measuring so gives more accurate display when compared with an 'averaging' meter such as an analogue panel meter or some lower specified digital multimeters. Accuracy of the controller is better than 1% of full scale. Ie Gen volts full scale is 333V ph-n so accuracy is ±3.33V (1% of 333V).

NOTE:- The above fault finding is provided as a guide check-list only. As the module can be configured to provide a wide range of different features, always refer to the source of your module configuration if in doubt.

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10. ROUTINE MAINTENANCE

10.1 Maintenance

WARNING

Hot engine and exhaust system can cause severe injury.

Do not touch hot engine parts.

Do not perform service or maintenance on generator until cool to the touch.

WARNING

Risk of severed digits or limbs.

Generator can be started from a remote switch.

Disconnect the negative (-) battery cable from generator battery before performing service or maintenance on generator set.

WARNING

Electrical shock can cause injury or death.

Ensure that all personnel operating, servicing, maintaining or working near this equipment are fully aware of the emergency procedures in case of accidents.

Maintenance must be performed on a regular basis to ensure the generator set performs properly and to extend the life of the generator set.

Generator set routine maintenance will depend on the installed location environment and application for which the generator set is used. Consider these factors when planning the maintenance schedule.

Stand-by generator sets installed in a clean and dry location will require at least a visual inspection once a month.

Stand-by generator sets installed in a dusty, damp or humid locations will require inspections and maintenance more frequently.

Refer to the engine manufacturer's manual for the scheduled maintenance on the engine.

Refer to the alternator manufacturer's manual for the scheduled maintenance on the alternator.

Standby generator set must be exercised at least once per month at a minimum of 70% load for one hour.

10.2 Lubrication and Maintenance Service Interval Chart - Standard Applications

	Lubrication and Maintenance Service Intervals			
Item	Daily	500 Hour/12 Month	2000 Hour/24 Month	As Required
Check Engine Oil and Coolant Level	•			
Check Fuel Filter/Water Bowl	•			
Check Air Cleaner Dust Unloader Valve & Restriction Indicator	•			
Gauge[a]	•			
Visual Walk Around Inspection		•		
Service Fire Extinguisher		•		
Check Engine Mounts		•		
Service Battery		•		
Check Manual Belt Tensioner and Belt Wear		•		
Change Engine Oil And Replace Oil Filter [b, c]		•		
Check Crankcase Vent System		•		
Check Air Intake Hoses, Connections, & System		•		
Replace Fuel Filter Elements		•		
Check Automatic Belt Tensioner and Belt Wear		•		
Check Engine Electrical Ground Connection		•		
Check Cooling System		•		
Coolant Solution Analysis-Add SCAs as required		•		
Pressure Test Cooling System		•		
Check Engine Speeds		•		
Flush and Refill Cooling System[d]			•	
Test Thermostats			•	
Check and Adjust Engine Valve Clearance			•	
Add Coolant				•
Replace Air Cleaner Elements				•
Replace Fan and Alternator Belts				•
Check Fuses				•
Check Air Compressor (If Equipped)				•
Bleed Fuel System				•

a Replace primary air cleaner element when restriction indicator shows a vacuum of 625 mm (25 in.) H2O.

b During engine break-in, change the oil and filter for the first time before 100 hours of operation.

c If the recommended engine oils, John Deere PLUS-50™, ACEA-E7 or ACEA E6 are not used, the oil and filter change interval is reduced. (see DIESEL ENGINE OIL AND FILTER INTERVALS chart). If diesel fuel with a sulfur content greater than 0.05% is used, the oil and filter change interval is also reduce.

d If John Deere COOL-GARD is used, the flushing interval may be extended to 3000 hours or 36 months. If John Deere COOL-GARD is used and the coolant is tested annually AND additives are replenished as needed by adding a supplemental coolant additive, the flushing interval may be extended to 5000 hours or 60 months, whichever occurs first.

10.3 Lubrication and Maintenance Service Interval Chart - Standby Applications

	Lubrication and Maintenance Service Intervals			
Item	**Every 2 Weeks**	**500 Hour/12 Month**	**2000 Hour/24 Month**	**As Required**
Operate Engine at Rated Speed and 50%–70% Load a Minimum of 30 Minutes	•			
Check Engine Oil and Coolant Level	•			
Check Fuel Filter/Water Bowl	•			
Check Air Cleaner Dust Unloader Valve & Restriction Indicator Gauge[a]	•			
Visual Walk Around Inspection	•	•		
Service Fire Extinguisher		•		
Check Engine Mounts		•		
Service Battery		•		
Check Manual Belt Tensioner and Belt Wear		•		
Change Engine Oil And Replace Oil Filter[b, c]		•		
Check Crankcase Vent System		•		
Check Air Intake Hoses, Connections, & System		•		
Replace Fuel Filter Elements		•		
Check Automatic Belt Tensioner and Belt Wear		•		
Check Engine Electrical Ground Connection		•		
Check Cooling System		•		
Coolant Solution Analysis-Add SCAs as required		•		
Pressure Test Cooling System			•	
Check Engine Speeds			•	
Adjust Variable Speed (Droop)			•	
Flush and Refill Cooling System				•
Test Thermostats				•
Check and Adjust Engine Valve Clearance				•
Add Coolant				•
Replace Air Cleaner Elements				•
Replace Fan and Alternator Belts				•
Check Fuses				•
Check Air Compressor (If Equipped)				•
Bleed Fuel System				•

a Replace primary air cleaner element when restriction indicator shows a vacuum of 625 mm (25 in.) H2O.

b During engine break-in, change the oil and filter for the first time before 100 hours of operation.

c If the recommended engine oils, John Deere PLUS-50™, ACEA-E7 or ACEA E6, are not used, the oil and filter change interval is reduced (see DIESEL ENGINE OIL AND FILTER INTERVALS chart). If diesel fuel with a sulfur content greater than 0.05% is used, the oil and filter change interval is also reduced.

11. ALTERNATOR

11.1 Generator Designation

HC(K) 534C2 (eg)

HC - Standard range Generators
HCK - Dedicated range (HC5 only)
I - Applications, M = Marine I = Industrial,
5 - Frame size, 4, 5, or 6
3 - Separate excitation, PMG
or
4 - Self Excited
4 - Number of poles, 4 or 6
C - Core Size
2 - Number of bearings, 1 or 2

The product is an AVR controlled, separately excited (by a shaft driven pilot exciter) synchronous 'ac generator' or a self excited (shunt arrangement). Designed for incorporation into a generating-set. (A generating-set is defined as 'machinery' in European directives).

11.2 Serial Number Location

Each generator has a unique serial number stamped into theupper section of the drive end of the frame.
The serial number is also shown on the nameplate.

Two other labels are located inside the terminal box, both fixed inside of the terminal box, one on the sheet metal-work and the other on the main frame of the generator. Neither of these two labels is considered to be permanently fixed.

11.3 Rating Plate

The generator has been supplied with a self-adhesive rating
plate label to enable fitting after final assembly and painting. Stick the nameplate to the outside of the non-drive end of the terminal box. The surface in the area where a label is to be stuck must be flat, clean, and any paint finish must be fully dry before attempting to attach label. Recommended method for attaching label is peel and fold back sufficient of the backing paper to expose some 20 mm of label adhesive along the edge which is to be located against the sheet metal protrusions. Once this first section of label has been carefully located and stuck into position progressively peel off the backing paper and smooth down with a clean cloth. The adhesive will achieve a permanent bond in 24 hours.

A factory fitted metal nameplate is available for some applications.

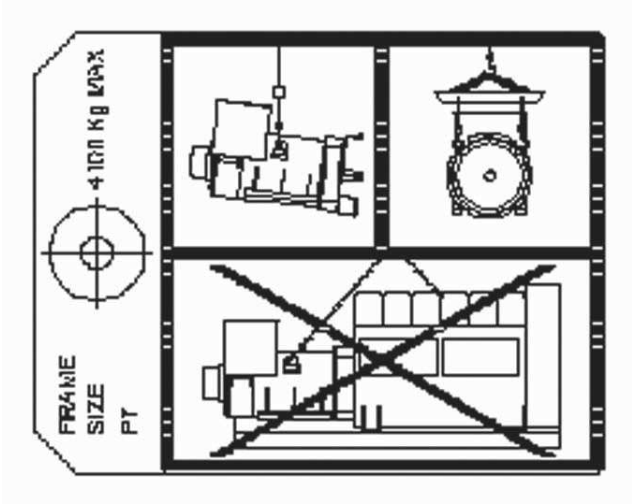
11. 11.4 Lifting

WARNING

The generator lifting points are designed to lift the generator only.

Do not lift the complete generating set by the generator lifting points.

When lifting the generator use a spreader bar to ensure that the angle on the lifting chains are vertical to the lifting position on the generator



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11.5 Automatic Voltage Regulators

To make AVR selections and adjustments remove the AVR cover and refer to the appropriate section depending upon type of AVR fitted. Reference to the generator nameplate will indicate AVR type.

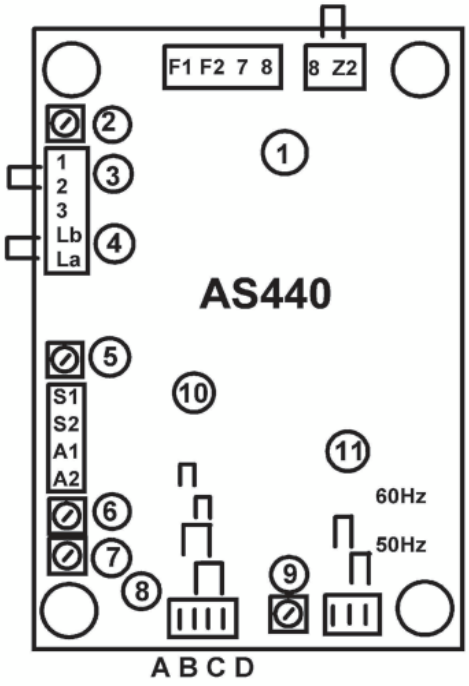
Most of the AVR adjustments are factory set in positions which will give satisfactory performance during initial running tests. Subsequent adjustment may be required to achieve optimum performance of the set under operating conditions.

11.5.1 Type AS440

1 - 8& Z2 linked for normal remove for auxiliary winding
2 - Output Voltage adjustment
3 - Hand trimmer link when not used
4 - Low voltage selection (110v)
5 - Droop adjustment
6 - To optimise analogue input sensitivity
7 - Excitement trip cut off adjustment
8 - Stability control
9 - UFRO adjustment
10 - Stability section
11 - Frequency section

Stability Selection

No.	Power range	Response
B-D	< 100kW	Slow
A-C	< 100kW	Fast
B-C	100-550kW	Fast
A-B	> 550kW	Fast



Initial Start Up

On completion of generating set assembly and before starting the generating set, ensure that all of the engine manufacturer's pre-running procedures have been completed, and that adjustment of the engine governor is such that the generator will not be subjected to speeds in excess of 125% of the rated speed.

Over-speeding the generator during initial setting of the speed governor can result in damage to the generator rotating components.

Voltage Set Up

The voltage is factory set as per the rating plate. If necessary adjust the voltage to the no load level as required.

To adjust the voltage remove the AVR access cover plate, use the insulated tool supplied.

Stability Set Up

The STABILITY control potentiometer is pre-set and should not normally require adjustment. If adjustment is necessary proceed as follows:

- Run the generating set on no-load and check that speed is correct and stable.
- Turn the STABILITY control potentiometer clockwise, and then turn slowly anti-clockwise until the generator voltage starts to become unstable. The correct setting is slightly clockwise from this position (i.e. where the machine volts are stable but close to the unstable region).

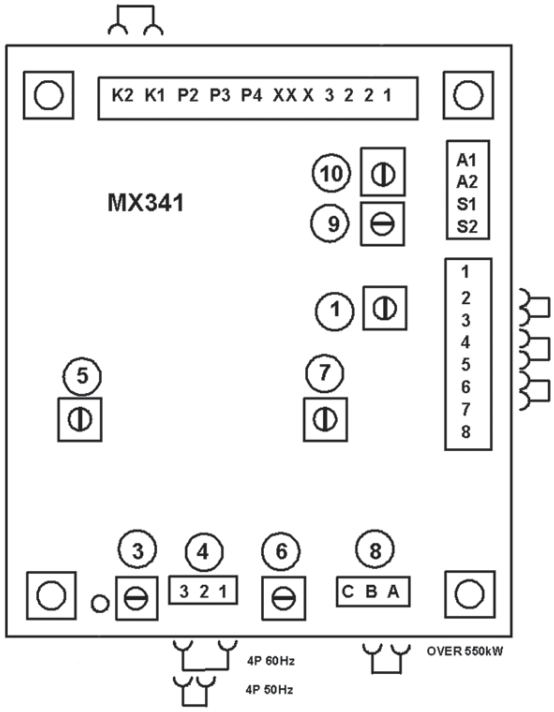
11.5.2 Type MX341

The following 'jumper' connections must be in the correct position for the correct number of poles and the operating frequency of the generator.

Frequency selection terminals
4 pole 50Hz LINK 2-3
4 pole 60Hz LINK 1-3

Stability selection terminals
LINK A-B

Excitation Interruption Link
K1-K2



1 - Volts
2 - Indicator led
3 - UFRO
4 - Frequency
5 - Dip
6 - Stability
7 - Excitation trip
8 - Stability section
9 - Droop
10 - Trim
11 - Link (over 550kW)
12 - Isolation link
13 - 2 x pin 2 use either
14 - Std. sensing links

Initial Start Up

On completion of generating set assembly and before starting the generating set, ensure that all of the engine manufacturer's pre-running procedures have been completed, and that adjustment of the engine governor is such that the generator will not be subjected to speeds in excess of 125% of the rated speed.

Over-speeding the generator during initial setting of the speed governor can result in damage to the generator rotating components.

Voltage Set Up

The voltage is factory set as per the rating plate. If necessary adjust the voltage to the no load level as required.
To adjust the voltage remove the AVR access cover plate, use the insulated tool supplied.

Stability Set Up

The STABILITY control potentiometer is pre-set and should not normally require adjustment. If adjustment is necessary proceed as follows:
- Run the generating set on no-load and check that speed is correct and stable.
- Turn the STABILITY control potentiometer clockwise, and then turn slowly anti-clockwise until the generator voltage starts to become unstable. The correct setting is slightly clockwise from this position (i.e. where the machine volts are stable but close to the unstable region).

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11.5.3 Type SX460

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

1. Field and sensing connections
2. Voltage adjustment
3. External hand trimmer selection,

With no external hand trimmer Link 1-2

With external hand trimmer – Remove Link 1-2 and connect trimmer across terminals 1 and 2.

4. AVR Input Selection

High Voltage (220/240V) Input No Link

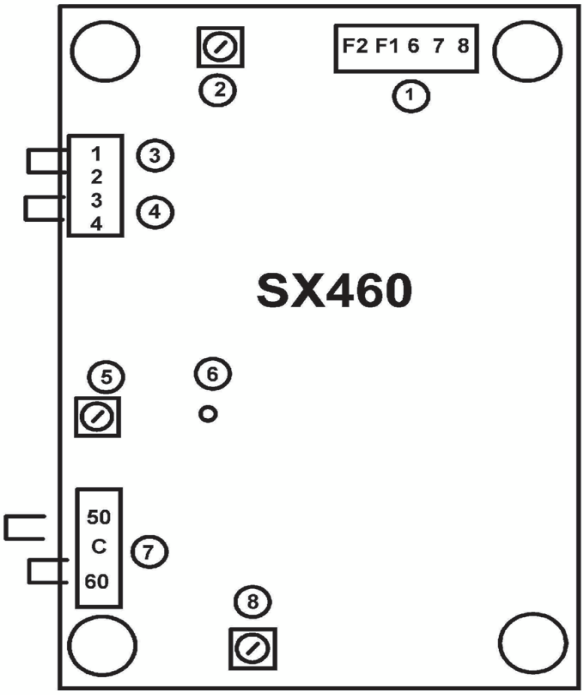
Low Voltage (110/120V) Input Link 3-4

5. UFRO adjustment
6. UFRO indication LED
7. Frequency selection

For 50Hz operation Link C-50

For 60Hz operation Link C-60

8. Stability control



During testing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing and/or adjustments. Refit all access covers after adjustments are completed.

On completion of generating set assembly and before starting the generating set ensure that all engine manufacturer's pre-running procedures have been completed, and that adjustment of the engine governor is such that the generator will not be subjected to speeds in excess of 125% of the rated speed.

Overspeeding of the generator during initial setting of the speed governor can result in damage to the generator rotating components.

In addition remove the AVR access cover (on AVR controlled generators) and turn volts control fully anti-clockwise. Start the generating set and run on no-load at nominal frequency. Slowly turn volts control potentiometer clockwise until rated voltage is reached. Refer to Fig. 1, 2 or 3 for control potentiometer location.

Do not increase the voltage above the rated generator voltage shown on the generator nameplate.

The stability control potentiometer should be set to the midway position (refer to fig 1, 2 or 3 for its location) and with the stability selection correctly set should not normally require adjustment. Should adjustment be required, usually identified by oscillation of the voltmeter, proceed as follows:

Run the generating set on no-load and check that speed is correct and stable.

Turn the stability control potentiometer clockwise, and then turn slowly anti-clockwise until the generator voltage starts to become unstable. The correct setting is slightly clockwise from this position (i.e. where the machine volts are stable but close to the unstable region).

11.5.4 Type MX321 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

MX321 jumper connections

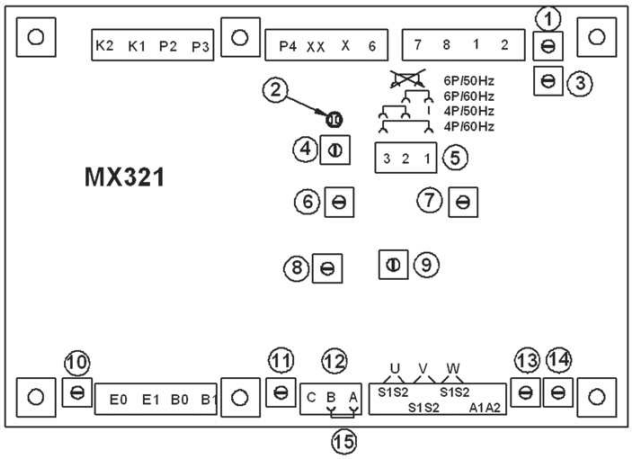
Frequency selection terminals

4 pole 50Hz operation - Link 2-3

4 pole 60Hz operation - Link 1-3

Stability selection terminals UC22 - Link A-B Stability selection terminals UC27 - Link B-C Excitation Interruption Link - K1-K2

1 - Volts
2 - Indicator led
3 - I/limit
4 - UFRO
5 - Frequency selector
6 - Dip
7 - rms
8 - Dwell
9 - Stability
10 - Over/v
11 - Exc trip
12 - Stability selector
13 - Droop
14 - Trim
15 - Link (over 550kW)



Initial Start Up

On completion of generating set assembly and before starting the generating set, ensure that all of the engine manufacturer's pre-running procedures have been completed, and that adjustment of the engine governor is such that the generator will not be subjected to speeds in excess of 125% of the rated speed.

Overspeeding the generator during initial setting of the speed governor can result in damage to the generator rotating components.

Voltage Set Up

The voltage is factory set as per the rating plate. If necessary adjust the voltage to the no load level as required. To adjust the voltage remove the AVR access cover plate, use the insulated tool supplied.

Stability Set Up

The STABILITY control potentiometer is pre-set and should not normally require adjustment. If adjustment is necessary proceed as follows:

Run the generating set on no-load and check that speed is correct and stable. Turn the STABILITY control potentiometer clockwise, then turn slowly anti-clockwise until the generator voltage starts to become unstable.

Note: The correct setting is slightly clockwise from this position (i.e. where the machine volts are stable but close to the unstable region).

11.6 Electrical Protection

It is the responsibility of the end user and contractors/sub- contractors to ensure that the overall system protection meets the needs of any inspectorate, local electricity authority or safety rules, pertaining to the site location.

WARNING

Incorrect installation and/or protective systems can result in injury and/or equipment damage.

Installers must be qualified to perform electrical installation work.

Adequate electrical protection must be provided so that there will be no danger to personnel, danger of fire or damage to the generator under fault conditions.

11.7 Fault Finding

WARNING

Service and fault finding procedures present hazards which can result in injury or death. Only personnel qualified to perform electrical and mechanical service should carry out these procedures. Ensure engine starting circuits are disabled before commencing service or maintenance procedures. Isolate any anti-condensation heater supply.

Important: Before commencing any fault finding procedure examine all wiring for broken or loose connections.

Four types of excitation control system, involving four types of AVR, can be fitted to the range of generators covered by this manual. The systems can be identified by a combination of AVR type, where applicable, and the last digit of the generator frame size designation. Refer to the generator nameplate then proceed to the appropriate subsection.

11.7.1 SX460 AVR

No voltage build-up when starting set.

1. Check speed
2. Check residual voltage.
3. Follow Separate Excitation Test Procedure to check generator and AVR.

Unstable voltage either on no-load or with load.

1. Check speed stability.
2. Check stability setting.

High voltage either on no-load or with load.

1. Check speed.
2. Check that generator load is not capacitive (leading power factor).

Low voltage, no load.

1. Check speed.
2. Check link 1-2 or external hand trimmer leads for continuity.

Low voltage on load.

1. Check speed.
2. Check UFRO setting.
3. Follow Separate Excitation Procedure to check generator and AVR.

11.7.2 SX440 AVR

No voltage build up when starting set.

1. Check link K1-K2 on auxiliary terminals.
2. Check speed
3. Check residual voltage. Refer to subsection 7.4.7.
4. Follow Separate Excitation Test Procedure to check generator and AVR. Refer to subsection 7.5.

Unstable voltage either on no-load or with load.

1. Check speed stability.
2. Check stability setting. Refer to subsection 4.6.

High voltage either on no-load or with load.

1. Check speed.
2. Check that generator load is not capacitive (leading power factor).

Low voltage no load.

1. Check speed.
2. Check link 1-2 or external hand trimmer leads for continuity.

Low voltage on load.

1. Check speed.
2. Check UFRO setting.
3. Follow Separate Excitation Procedure to check generator and AVR.

11.7.3 SX421 AVR

No voltage build-up when starting set.

1. Check circuit breaker ON.
2. Check speed.
3. Check residual voltage. Refer to subsection 7.4.7.
4. Follow Separate Excitation Test Procedure to check generator and AVR.

Unstable voltage either on no-load or with load.

1. Check speed stability.
2. Check stability setting.

High voltage either on no-load or with load.

1. Check speed.
2. Check link 1-2 or external hand trimmers leads for continuity. Check continuity of leads 7-8 and P3-P2 for continuity.
3. Check that generator load is not capacitive (leading power factor).

Low voltage no load.

1. Check speed.
2. Check link 1-2 or external hand trimmer leads for continuity.

Low voltage on load.

1. Check speed.
2. Check UFRO setting. Refer to subsection 4.7.1.1.
3. Follow Separate Excitation Procedure to check generator and AVR.

Excessive voltage/speed dip on load switching.

1. Check governor response.
2. Refer to generating set manual. Check 'DIP' setting.

11.7.4 Transformer Control

No voltage build-up when starting set.

1. Check transformers rectifiers.
2. Check transformer secondary winding for open circuit.

Low voltage.

1. Check speed.
2. Check transformer air gap setting.

High voltage.

1. Check speed.
2. Check transformer air gap setting.
3. Check transformer secondary winding for open circuit.

Excessive voltage/speed dip on load switching.

1. Check speed drop on-load.
2. Check transformers rectifiers.
3. Check transformer air gap setting.

11.7.5 MX341 AVR

No voltage build-up when starting set.

1. Check link K1-K2 on auxiliary terminals
2. Follow Separate Excitation Test Procedure to check machine and AVR.

Loss of voltage when set running.

1. First stop and restart set. If no voltage or voltage collapses after short time, follow Separate Excitation Test Procedure.

Generator voltage high followed by collapse.

1. Check sensing leads to AVR.
2. Refer to Separate Excitation Test Procedure.

Voltage unstable, either on no-load or with load.

1. Check speed stability.
2. Check "STAB" setting. Refer to Load Testing section for procedure.

Low voltage on load.

1. Check speed.
2. If correct check "UFRO" setting.

Excessive voltage/speed dip on load switching.

1. Check governor response. Refer to generating set manual. Check "DIP" setting.

Sluggish recovery on load switching.

1. Check governor response. Refer to generating set manual.

11.7.6 MX321 AVR

No voltage build-up when starting set.

1. Check link K1-K2 on auxiliary terminals. Follow Separate Excitation Test Procedure to check machine and AVR.

Voltage very slow to build up.

1. Check setting of ramp potentiometer.

Loss of voltage when set running.

1. First stop and restart set. If no voltage or voltage collapses after short time, follow Separate Excitation Test Procedure.

Generator voltage high followed by collapse.

1. Check sensing leads to AVR.
2. Refer to Separate Excitation Test Procedure.

Voltage unstable, either on no-load or with load.

1. Check speed stability.
2. Check "STAB" setting. Refer to Load Testing section for procedure.

Low voltage on load.

1. Check speed.
2. If correct check "UFRO" setting.

Excessive voltage/speed dip on load switching.

1. Check governor response. Refer to generating set manual. Check "DIP" setting.

Sluggish recovery on load switching.

1. Check governor response. Refer to generating set manual. Check "DWELL" setting.

11.8 Alternator Maintenance

WARNING

Service and fault finding procedures present hazards which can result in injury or death. Only personnel qualified to perform electrical and mechanical service should carry out these procedures. Ensure engine starting circuits are disabled before commencing service or maintenance procedures. Isolate any anti- condensation heater supply.

As part of routine maintenance procedures, periodic attention to winding condition (particularly when generators have been idle for a long period) and bearings is recommended.

When generators are fitted with air filters regular inspection and filter maintenance is required.

11.8.1 Winding Condition

Warning: Service and fault finding procedures present hazards which can result in l injury or death. Only personnel qualified to perform electrical and mechanical service should carry out these procedures. Ensure engine starting circuits are disabled before commencing service or maintenance procedures. Isolate any anti-condensation heater supply.

11.8.2 Guidance Of Typical Insulation Resistance [IR] Values

The following is offered as general information about IR values and is aimed at providing guidance about the typical IR values for generators from new through to the point of refurbishment.

Generators In Service

It is known that a generator will give reliable service with an IR value of just 1.0 MΩ. For a relatively new generator to be so low it must have been subjected to inappropriate operating or storage conditions.

Any temporarily reduction in IR values can be restored to expected values by following one of the drying out procedures.

11.8.3 Winding Condition Assessment

The AVR should be disconnected and the Resistance Temperature Detector (R.T.D.) leads grounded during this test.

NOTICE:

The AVR must be disconnected and the resistance Temperature Detector (R.T.D.) leads grounded during this test.

The condition of the windings can be assessed by measurement of insulation resistance [IR] between phase to phase, and phase to earth.

Measurement of winding insulation should be carried out:

1. As part of a periodic maintenance plan.
2. After prolonged periods of shutdown.
3. When low insulation is suspected, e.g. damp or wet windings.

Care should be taken when dealing with windings that are suspected of being excessively damp or dirty. The initial measurement of the [IR] Insulation Resistance should be established using a low voltage (500V) megger type instrument. If manually powered the handle should initially be turned slowly so that the full test voltage will not be applied, and only applied for long enough to very quickly assess the situation if low values are suspected or immediately indicated.

Full megger tests or any other form of high voltage test should not be applied until the windings have been dried out and if necessary cleaned.

11.9 Replacement Parts

Contact your Himoinsa Power System dealer or distributor to order parts. Have your genset serial and model number when ordering parts.

12. SPECIFICATIONS JOHN DEERE

12.1 Generator Set Models

Generator Set Model	Voltage	Engine Model	Alternator Model
HJW 30 M6	120/240V 1Ph - 60HZ	4024 TF281-36	PI 144 K
HJW 55 M6	120/240V 1Ph - 60 Hz	4045 TF280-63	UCI 224 G
HJW 70 M6	120/240V 1Ph - 60 Hz	4045 HF280-74	UCI 274 D
HJW 85 M6	120/240V 1Ph - 60 Hz	4045 HF285-94	UCI 274 E
HJW 30 T6	120/208V 3 Ph - 60 Hz	4024TF281 - 36	PI 144 G
HJW 55 T6	120/208V 3 Ph - 60 Hz	4045TF280 - 63	UCI 224 D
HJW 65 T6	120/208V 3 Ph - 60 Hz	4045HF280 - 74	UCI 224 F
HJW 85 T6	120/208V 3 Ph - 60 Hz	4045HF285 - 94	UCI 224 G
HJW 105 T6	120/208V 3 Ph - 60 Hz	4045HF285 - 118	UCI 274 D
HJW 130 T6	120/208V 3 Ph - 60 Hz	4045HF285 - 147	UCI 274 E
HJW 155 T6	120/208V 3 Ph - 60 Hz	6068HF285 - 177	UCI 274 F
HJW 205 T6	120/208V 3 Ph - 60 Hz	6068HF485 - 235	UCI 274 H
HJW 225 T6	120/208V 3 Ph - 60 Hz	6090HF484 - 258	UCDI 274 J
HJW 275 T6	120/208V 3 Ph - 60 Hz	6090HF484 - 315	HCI 444 D
HJW 305 T6	120/208V 3 Ph - 60 Hz	6135HF485 - 345	HCI 444 D
HJW 355 T6	120/208V 3 Ph - 60 Hz	6135HF485 - 401	HCI 444 E
HJW 410 T6	120/208V 3 Ph - 60 Hz	6135HF485 - 460	HCI 444 F
HJW 30 T6	277/480V 3 Ph - 60 Hz	4024TF281 - 36	PI 144 G
HJW 55 T6	277/480V 3 Ph - 60 Hz	4045TF280 - 63	UCI 224 D
HJW 65 T6	277/480V 3 Ph - 60 Hz	4045HF280 - 74	UCI 224 E
HJW 85 T6	277/480V 3 Ph - 60 Hz	4045HF285 - 94	UCI 224 F
HJW 105 T6	277/480V 3 Ph - 60 Hz	4045HF285 - 118	UCI 274 C
HJW 130 T6	277/480V 3 Ph - 60 Hz	4045HF285 - 147	UCI 274 D
HJW 155 T6	277/480V 3 Ph - 60 Hz	6068HF285 - 177	UCI 274 E
HJW 205 T6	277/480V 3 Ph - 60 Hz	6068HF485 - 235	UCI 274 G
HJW 225 T6	277/480V 3 Ph - 60 Hz	6090HF484 - 258	UCI 274 H
HJW 275 T6	277/480V 3 Ph - 60 Hz	6090HF484 - 315	HCI 444 C
HJW 305 T6	277/480V 3 Ph - 60 Hz	6135HF485 - 345	HCI 444 D
HJW 355 T6	277/480V 3 Ph - 60 Hz	6135HF485 - 401	HCI 444 E
HJW 410 T6	277/480V 3 Ph - 60 Hz	6135HF485 - 460	HCI 444 F
HRJW 35 T6	120-480V 1 & 3 Ph - 60 Hz	4024TF281 - 36	PI 144 G
HRJW 60 T6	120-480V 1 & 3 Ph - 60 Hz	4045TF280 - 63	UCI 224 D
HRJW 75 T6	120-480V 1 & 3 Ph - 60 Hz	4045HF280 - 74	UCI 224 F
HRJW 90 T6	120-480V 1 & 3 Ph - 60 Hz	4045HF285 - 94	UCI 224 G
HRJW 115 T6	120-480V 1 & 3 Ph - 60 Hz	4045HF285 - 118	UCI 274 D
HRJW 145 T6	120-480V 1 & 3 Ph - 60 Hz	4045HF285 - 147	UCI 274 E
HRJW 175 T6	120-480V 1 & 3 Ph - 60 Hz	6068HF285 - 177	UCI 274 F
HRJW 235 T6	120-480V 1 & 3 Ph - 60 Hz	6068HF485 - 235	UCI 274 H
HRJW 250 T6	120-480V 1 & 3 Ph - 60 Hz	6090HF484 - 258	UCDI 274 J
HRJW 310 T6	120-480V 1 & 3 Ph - 60 Hz	6090HF484 - 315	HCI 444 D
HRJW 340 T6	120-480V 1 & 3 Ph - 60 Hz	6135HF485 - 345	HCI 444 D
HRJW 400 T6	120-480V 1 & 3 Ph - 60 Hz	6135HF485 - 401	HCI 444 E
HRJW 460 T6	120-480V 1 & 3 Ph - 60 Hz	6135HF485 - 460	HCI 444 F

12.2 UL 2200 Generator Set Models

Generator Set Model	Voltage	Engine Model	Alternator Model
HJW 30 M6	120/240V 1Ph - 60HZ	4024 TF281-36	UCI 224 D
HJW 55 M6	120/240V 1Ph - 60HZ	4045 TF280-63	UCI 274 E
HJW 70 M6	120/240V 1Ph - 60HZ	4045 HF280-74	UCI 274 E
HJW 85 M6	120/240V 1Ph - 60HZ	4045 HF285-94	UCI 274 F
HJW 30 T6	120/208V 3 Ph - 60 Hz	4024TF281 - 36	PI 144 J
HJW 55 T6	120/208V 3 Ph - 60 Hz	4045TF280 - 63	UCI 224 F
HJW 65 T6	120/208V 3 Ph - 60 Hz	4045HF280 - 74	UCI 224 G
HJW 85 T6	120/208V 3 Ph - 60 Hz	4045HF285 - 94	UCI 274 D
HJW 105 T6	120/208V 3 Ph - 60 Hz	4045HF285 - 118	UCI 274 E
HJW 130 T6	120/208V 3 Ph - 60 Hz	4045HF285 - 147	UCI 274 F
HJW 155 T6	120/208V 3 Ph - 60 Hz	6068HF285 - 177	UCI 274 G
HJW 205 T6	120/208V 3 Ph - 60 Hz	6068HF485 - 235	UCDI 274 K
HJW 225 T6	120/208V 3 Ph - 60 Hz	6090HF484 - 258	HCI 444 D
HJW 275 T6	120/208V 3 Ph - 60 Hz	6090HF484 - 315	HCI 444 E
HJW 305 T6	120/208V 3 Ph - 60 Hz	6135HF485 - 345	HCI 444 F
HJW 355 T6	120/208V 3 Ph - 60 Hz	6135HF485 - 401	HCI 544 C
HJW 410 T6	120/208V 3 Ph - 60 Hz	6135HF485 - 460	HCI 544 D
HJW 30 T6	277/480V 3 Ph - 60 Hz	4024TF281 - 36	PI 144 J
HJW 55 T6	277/480V 3 Ph - 60 Hz	4045TF280 - 63	UCI 224 F
HJW 65 T6	277/480V 3 Ph - 60 Hz	4045HF280 - 74	UCI 224 G
HJW 85 T6	277/480V 3 Ph - 60 Hz	4045HF285 - 94	UCI 274 D
HJW 105 T6	277/480V 3 Ph - 60 Hz	4045HF285 - 118	UCI 274 E
HJW 130 T6	277/480V 3 Ph - 60 Hz	4045HF285 - 147	UCI 274 F
HJW 155 T6	277/480V 3 Ph - 60 Hz	6068HF285 - 177	UCI 274 G
HJW 205 T6	277/480V 3 Ph - 60 Hz	6068HF485 - 235	UCDI 274 K
HJW 225 T6	277/480V 3 Ph - 60 Hz	6090HF484 - 258	HCI 444 D
HJW 275 T6	277/480V 3 Ph - 60 Hz	6090HF484 - 315	HCI 444 F
HJW 305 T6	277/480V 3 Ph - 60 Hz	6135HF485 - 345	HCI 444 F
HJW 355 T6	277/480V 3 Ph - 60 Hz	6135HF485 - 401	HCI 544 C
HJW 410 T6	277/480V 3 Ph - 60 Hz	6135HF485 - 460	HCI 544 D

12.3 Engine Models

12.3.1 4024TF281

Engine Type	In-line 4 Cylinder Diesel Engine
Bore & Stroke	3.4 in. (86 mm) x 4.1 in. (105 mm)
Displacement	149 cu. in. (2.4 L)
Compression Ratio	20.5 : 1
Valves Per Cylinder	1 Intake / 1 Exhaust
Combustion System	Direct Injection
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Oil Pressure At Low Idle	N/A
Oil Pressure At Rated Speed	43 psi (296 kPa)
Rated Horsepower Hp (kW)	Prime - 43 (32) Standby - 49 (36)
Rated Speed rpm	1800
Low Idle	N/A
Dimensions Without Radiator	26.1 x 22.3 x 30.4 in. (662 x 566 x 772 mm)
Weight With Flywheel And Housing (dry)	553 lb (251 kg)

12.3.2 4045TF280

Engine Type	In-line 4 Cylinder Diesel Engine
Bore & Stroke	4.19 in. (106 mm) x 5.0 in. (127 mm)
Displacement	275 cu. in. (4.5 L)
Compression Ratio	19.0 : 1
Valves Per Cylinder	1 Intake / 1 Exhaust
Combustion System	Direct Injection
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Oil Pressure At Low Idle	15 psi (105 kPa)
Oil Pressure At Rated Speed	46 psi (320 kPa)
Rated Horsepower Hp (kW)	Prime - 76 (57) Standby - 85 (63)
Rated Speed rpm	1800
Low Idle	1150
Rated Torque Lb/Ft (N•m)	Prime - 409 (302) Standby - 453 (334)
Dimensions Without Radiator	33.9 x 24.1 x 39.1 in. (860 x 612 x 994 mm)
Weight With Oil, Flywheel And Housing	872 lb (396 kg)

12.3.3 4045HF-280

Engine Type	In-line 4 Cylinder Diesel Engine
Bore & Stroke	4.19 in. (106 mm) x 5.0 in. (127 mm)
Displacement	275 cu. in. (4.5 L)
Compression Ratio	19.0 : 1
Valves Per Cylinder	1 Intake / 1 Exhaust
Combustion System	Direct Injection
Cooling System	Liquid Cooled
Aspiration	Intercooled
Charge Air Cooling System	Air-To-Air
Oil Pressure At Low Idle	15 psi (105 kPa)
Oil Pressure At Rated Speed	50 psi (345 kPa)
Rated Horsepower Hp (kW)	Prime - 90 (67) Standby - 99 (74)
Rated Speed rpm	1800
Low Idle	1150
Rated Torque Lb/Ft (N•m)	N/A
Dimensions Without Radiator	33.9 x 24.1 x 40.9 in. (860 x 612 x 1039 mm)
Weight With Flywheel And Housing (dry)	1083 lb (491 kg)

12.3.4 4045HF285

Engine Type	In-line 4 Cylinder Diesel Engine
Bore & Stroke	4.19 in. (106 mm) x 5.0 in. (127 mm)
Displacement	275 cu. in. (4.5 L)
Compression Ratio	19.0 : 1
Valves Per Cylinder	1 Intake / 1 Exhaust
Combustion System	Unit Injection
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Charge Air Cooling System	Air-To-Air
Oil Pressure At Low Idle	15 psi (105 kPa)
Oil Pressure At Rated Speed	46 psi (320 kPa)
Rated Horsepower Hp (kW)	Prime - 115 (86) Standby - 126 (94)
Rated Speed rpm	1800
Low Idle	1150
Rated Torque Lb/Ft (N•m)	Prime - 772 (569) Standby - 849 (626)
Dimensions Without Radiator	33.9 x 24.1 x 40.9 in. (860 x 612 x 1039 mm)
Weight With Oil, Flywheel And Housing	1083 lb (491 kg)

12.3.5 4045HF-285

Engine Type	In-line 4 Cylinder Diesel Engine
Bore & Stroke	4.19 in. (106 mm) x 5.0 in. (127 mm)
Displacement	275 cu. in. (4.5 L)
Compression Ratio	19.0 : 1
Valves Per Cylinder	1 Intake / 1 Exhaust
Combustion System	Unit Injection
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Charge Air Cooling System	Air-To-Air
Oil Pressure At Low Idle	15 psi (105 kPa)
Oil Pressure At Rated Speed	46 psi (320 kPa)
Rated Horsepower Hp (kW)	Prime - 144 (107) Standby - 158 (118)
Rated Speed rpm	1800
Low Idle	1150
Rated Torque Lb/Ft (N•m)	Prime - 772 (569) Standby - 849 (626)
Dimensions Without Radiator	33.9 x 24.1 x 40.9 in. (860 x 612 x 1039 mm)
Weight With Flywheel And Housing (dry)	1083 lb (491 kg)

12.3.6 4045HF285

Engine Type	In-line 4 Cylinder Diesel Engine
Bore & Stroke	4.19 in. (106 mm) x 5.0 in. (127 mm)
Displacement	275 cu. in. (4.5 L)
Compression Ratio	19.0 : 1
Valves Per Cylinder	1 Intake / 1 Exhaust
Combustion System	Unit Injection
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Charge Air Cooling System	Air-To-Air
Oil Pressure At Low Idle	15 psi (105 kPa)
Oil Pressure At Rated Speed	46 psi (320 kPa)
Rated Horsepower Hp (kW)	Prime - 179 (134) Standby - 197 (147)
Rated Speed rpm	1800
Low Idle	1150
Rated Torque Lb/Ft (N•m)	Prime - 961 (709) Standby - 1057 (780)
Dimensions Without Radiator	33.9 x 24.1 x 40.9 in. (860 x 612 x 1039 mm)
Weight With Oil, Flywheel And Housing	1083 lb (491 kg)

12.3.7 6068HF-285

Engine Type	In-line 6 Cylinder Diesel Engine
Bore & Stroke	4.19 in. (106 mm) x 5.0 in. (127 mm)
Displacement	415 cu. in. (6.8 L)
Compression Ratio	19.0 : 1
Valves Per Cylinder	2 Intake / 2 Exhaust
Combustion System	Unit Injection
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Charge Air Cooling System	Air-To-Air
Oil Pressure At Low Idle	15 psi (105 kPa)
Oil Pressure At Rated Speed	44 psi (300 kPa)
Rated Horsepower Hp (kW)	Prime - 216 (161) Standby - 237 (177)
Rated Speed rpm	1800
Low Idle	1150
Rated Torque Lb/Ft (N•m)	Prime - 1151 (849) Standby - 1266 (934)
Dimensions Without Radiator	44.2 x 25.9 x 40.8 in. (1123 x 657 x 1036 mm)
Weight With Flywheel And Housing (dry)	1340 lb (608 kg)

12.3.8 6068HF-485

Engine Type	In-line 6 Cylinder Diesel Engine
Bore & Stroke	4.19 in. (106 mm) x 5.0 in. (127 mm)
Displacement	415 cu. in. (6.8 L)
Compression Ratio	17.0 : 1
Valves Per Cylinder	2 Intake / 2 Exhaust
Combustion System	Unit Injection
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Charge Air Cooling System	Air-To-Air
Oil Pressure At Low Idle	15 psi (105 kPa)
Oil Pressure At Rated Speed	49 psi (339 kPa)
Rated Horsepower Hp (kW)	Prime - 286 (214) Standby - 315 (235)
Rated Speed rpm	1800
Low Idle	1150
Rated Torque Lb/Ft (N•m)	Prime - 1536 (1133) Standby - 1690 (1247)
Dimensions Without Radiator	45.7 x 24.3 x 44.5 in. (1161 x 616 x 1128 mm)
Weight With Oil, Flywheel And Housing	1495 lb (678 kg)

12.3.9 6090HF-484

Engine Type	In-line 6 Cylinder Diesel Engine
Bore & Stroke	4.661 in. (118.4 mm) x 5.354 in. (136 mm)
Displacement	549 cu. in. (9.0 L)
Compression Ratio	16.0 : 1
Valves Per Cylinder	2 Intake / 2 Exhaust
Combustion System	High Pressure Common Rail
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Charge Air Cooling System	Air-To-Air
Oil Pressure At Low Idle	28 psi (190 kPa)
Oil Pressure At Rated Speed	38 psi (260 kPa)
Rated Horsepower Hp (kW)	Prime - 380 (284) Standby - 422 (315)
Rated Speed rpm	1800
Low Idle	1000
Rated Torque Lb/Ft (N•m)	Prime - 2039 (1504) Standby - 2266 (1671)
Dimensions Without Radiator	47.6 x 24.8 x 43.8 in. (1208 x 630 x 1113 mm)
Weight With Flywheel And Housing (dry)	1986 lb (901 kg)

12.3.10 6135HF-485

Engine Type	In-line 6 Cylinder Diesel Engine
Bore & Stroke	5.20 in. (132 mm) x 6.50 in. (165 mm)
Displacement	824 cu. in. (13.5 L)
Compression Ratio	16.0 : 1
Valves Per Cylinder	2 Intake / 2 Exhaust
Combustion System	Unit Injection
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Charge Air Cooling System	Air-To-Air
Oil Pressure At Low Idle	20 psi (138 kPa)
Oil Pressure At Rated Speed	42 psi (287 kPa)
Rated Horsepower Hp (kW)	Prime - 561 (419) Standby - 617 (460)
Rated Speed rpm	1800
Low Idle	900
Rated Torque Lb/Ft (N•m)	Prime - 3011 (2221) Standby - 3309 (2440)
Dimensions Without Radiator	52.5 x 33.7 x 59.5 in. (1334 x 855 x 1512 mm)
Weight With Flywheel And Housing (dry)	3292 lb (1493 kg)

13. SPECIFICATIONS YANMAR

13.1 Engine Models

13.1.1 4TNV84T

Engine Type	In-line 4 Cylinder Diesel Engine
Bore & Stroke	3.31 in. (84 mm) x 3.54 in. (90 mm)
Displacement	122 cu. in. (2.0 L)
Compression Ratio	18.9 : 1
Combustion System	Direct Injection
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Rated Horsepower Bhp (kWm)	37.1 (27.7)
Rated Speed rpm	1800
Dimensions, Open Skid	66.9 x 24.4 x 50.4 in. (1700 x 620 x 1280 mm)
Dimensions, Sound Attenuated	88.6 x 43.3 x 52.8 in. (2250 x 1100 x 1340 mm)
Weight, Open Skid With Radiator	917 lb (416 kg)
Weight, Sound Attenuated	2315 lb (1050 kg)

13.1.2 4TNV88

Engine Type	In-line 4 Cylinder Diesel Engine
Bore & Stroke	3.46 in. (88 mm) x 3.54 in. (90 mm)
Displacement	134 cu. in. (2.19 L)
Compression Ratio	19.1 : 1
Combustion System	Direct Injection
Cooling System	Liquid Cooled
Aspiration	Natural
Rated Horsepower Bhp (kWm)	30.2 (22.5)
Rated Speed rpm	1800
Dimensions, Open Skid	57.1 x 24.4 x 50.4 in. (1450 x 620 x 1280 mm)
Dimensions, Sound Attenuated	88.6 x 43.3 x 52.8 in. (2250 x 1100 x 1340 mm)
Weight, Open Skid With Radiator	1003 lb (455 kg)
Weight, Sound Attenuated	975 lb (2150 kg)

13.1.3 4TNV98

Engine Type	In-line 4 Cylinder Diesel Engine
Bore & Stroke	3.31 in. (84 mm) x 3.54 in. (90 mm)
Displacement	203 cu. in. (3.32 L)
Compression Ratio	18.5 : 1
Combustion System	Direct Injection
Cooling System	Liquid Cooled
Aspiration	Natural
Rated Horsepower Bhp (kWm)	55.8 (41.6)
Rated Speed rpm	1800
Dimensions, Open Skid	76.8 x 30.7 x 50.4 in. (1950 x 620 x 1340 mm)
Dimensions, Sound Attenuated	88.6 x 43.3 x 52.8 in. (2250 x 1100 x 1340 mm)
Weight, Open Skid With Radiator	1332 lb (604 kg)
Weight, Sound Attenuated	2315 lb (1050 kg)

13.1.4 4TNV98T

Engine Type	In-line 4 Cylinder Diesel Engine
Bore & Stroke	3.86 in. (98 mm) x 4.33 in. (110 mm)
Displacement	203 cu. in. (3.32 L)
Compression Ratio	18.1 : 1
Combustion System	Direct Injection
Cooling System	Liquid Cooled
Aspiration	Turbocharged
Rated Horsepower Bhp (kWm)	68.4 (51.0)
Rated Speed rpm	1800
Dimensions, Open Skid	76.8 x 30.7 x 50.4 in. (1950 x 780 x 1280 mm)
Dimensions, Sound Attenuated	88.6 x 43.3 x 52.8 in. (2250 x 1100 x 1340 mm)
Weight, Open Skid With Radiator	1584 lb (702 kg)
Weight, Sound Attenuated	2513 lb (1140 kg)

14. PERIODIC MAINTENANCE YANMAR

O=Check X= Replace •= Contact your authorized Yanmar dealer or distributor

System	Check Item	Daily	Every 50 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	Every 1500 Hours	Every 2000 Hours
Cooling System	Check and refill engine coolant	O						
	Check and clean radiator fins			O				
	Check and adjust cooling fan V-belt		O 1st time	O 2nd and after				
	Drain, flush and refill cooling system with new coolant					X or every year whichever comes first		
Cylinder Head	Adjust intake / exhaust valve clearance					•		
	Lap intake / exhaust valve seats							•
Electrical Equipment	Check indicators	O						
Engine Oil	Check battery		O					
	Check engine oil level	O						
	Drain and fill engine oil		X 1st time	X 2nd and after				
	Replace engine oil filter							
Engine Speed Control	Check and adjust governor lever and engine speed control	O		O				
Emission Control Warranty	Inspect, clean and test fuel injectors						•	
	Inspect turbocharger (if equipped) (blower wash as necessary)						•	
	Inspect crankcase breather system						•	
Fuel	Check and refill fuel tank	O						
	Drain fuel tank			O				
	Drain fuel / water separator		O					
	Check fuel / water separator	O						
	Clean fuel / water separator				O			
	Replace fuel filter				X			
Hoses	Replace fuel system and cooling system hoses							• or every 2 years
Intake and Exhaust	Clean or replace air cleaner element			O	X			
Complete Engine	Overall visual inspection daily	O						

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15. SAFETY REGULATIONS

Before operating the machine, read the following safety regulations carefully, and find out about the local requirements in safety.
The installation, operation, maintenance and repairs must be carried out only by authorized and competent personnel.
The owner is responsible for maintaining the generating set in good safety conditions. The parts and accessories must be replaced if they are not in good working conditions.

15.1. General safety precautions.

- Do not allow non-authorized people to access the plant.
- Do not allow people with pacemakers to access the plant, as it may cause electromagnetic interferences on these devices.
- Do not approach the G.S. if you are wearing loose clothes or objects that may be attracted by the airflow or by the mobile parts of the engine.
- It is forbidden to dismantle or disable any safety devices.
- It is forbidden to lean on the G.S. or to leave objects on it.

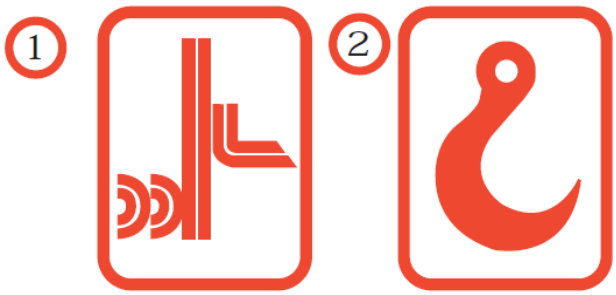
For automatic action generating sets:

- Place a red light that switches on when the unit is working in a visible place.
- Place a warning sign alerting of the possibility that an unexpected automatic startup of the machine may occur.
- Place an obligation sign stating: “All maintenance operations must be carried out with the generator in the LOCK position”.
- For the emergency stop of the group, press the “emergency stop” button, located in the group, or the emergency push button to be installed outside the engine room.

15.2. Safety at delivery, storage and unpacking.

- Once you receive the lighting tower, check that the received goods correspond to those on the delivery note and that all the goods are in perfect conditions.
- In order to lift and transport the Tower, lifting machines of the appropriate capacity must be used. All loose and pivoting parts must be safely fixed before lifting it.

When moving the G.S., and especially when lifting it, it is highly recommendable to use the available points for this purpose. (1-2)



- It is totally forbidden to use any other lifting points located over the engine, alternator or other components.
- If the G.S. is damaged for any reason during its transportation, storage, and/or mounting, it must not be started up before being verified by our specialized personnel.
- If you want to store the Tower until its utilization, it is highly recommendable to have a warehouse properly protected against any chemical agents that may damage its components.
- Unpacking must be carried out carefully, avoiding causing any damages to the goods during such operation, especially when using levers, saws or any other metallic tools.

15.3. Safety during installation and initial start-up

- The installation of the generator set and its respective accessories must be carried out by specialized personnel. In the event of any difficulties during the installation, consult with the Technical Department at Himoinsa.
- You must be familiar with the emergency procedures concerning the installation to be followed.
- Always wear a safety helmet, footwear and safety gloves, protective goggles and dry, tight clothes.
- Do not modify the original protections, located on all rotary parts on display, hot surfaces, air intakes, belts and live parts.
- Do not leave dismantled parts, tools or any other accessories on the engine, near the engine or in the area where the generator set is located.
- Do not leave any flammable liquids or rags soaked in flammable liquids near the generator set, electrical devices or any other parts of the electrical installation (including lamps)Take extreme caution to avoid risks of fulguration; make sure there is a grounding installation and that it has been fitted according to the regulations.
- Place a sign stating: “DO NOT PERFORM MANOUVERS” in all sectioning parts that

separate the areas of the installation where you are to work.

- Install all the necessary protective measures required for safety in the parts that complete the installation.
- Insulate all connections and wires that are disconnected. Do not leave any terminals of the generator sets unprotected.
- Plug all connection points concerning the generator set and its accessories into the grounding installation.
- Verify and make sure the electrical power connections and the auxiliary services connections are correctly made.
- Check that the cyclical direction of the phases matches the one of the power supply.
- Isolate the position of the emergency stop switches, quick-stop fuel valves, switches and other incidental emergency systems existing in the installation.
- Verify the perfect functionality of the stop devices of the set, especially those in the following devices (in case they are standard supplies): overspeed stop, low oil pressure stop, high water temperature in the engine stop, and the user-installed emergency stop switch, which is usually outside the premises.
- Check the correct ventilation of the premises so that the exhaust gases can be released to the atmosphere, to the exterior of the premises, and verify that they are in a safe position away from doors, windows and air intakes.
- Check that pipes and silencers are installed in a correct way. They must have expansion joints and be protected against accidental contact.
- Make sure there are no losses or leaks in the oil and fuel pipes.
- Before the starting-up, make sure the generator set has the right amount of lubricant oil, cooling liquid and fuel.
- Single out the position of the fire extinguishers and other protective and emergency devices, and learn how they work.
- Single out the sources of dangers, such as fuel leaks, lubricant oil, acid solutions, condensed drippings, high pressures and other dangers.
- Check that the set is clean and the surrounding area and escape routes are clear and free of obstacles. Check that there are no obstructions on grilles, intakes and outlets.
- Check that there are staff members working at other nearby sets, and that those tasks are not dangerous and may affect the operation of the system.

15.4. Safety during operation

- Do not allow people or animals to access the operating area of the G.S..
- Do not touch the generator set, especially wires and connections to the alternator when the set is operating, since they are live.
- Do not touch any parts in motion, until the generator set has stopped completely.
- When the G.S. is in operation, some parts of the engine, conduit(s) and exhaust reach high temperatures. Avoid touching them until they have cooled down completely.
- Always wear ear protectors when the generator set is in operation, in order to avoid ear damage.
- The labels concerning safety must be kept clean and on the locations designated by the manufacturer.
- Fuels and lubricants may be flammable, toxic, explosive and corrosive. We recommend keeping them in their original containers and storing them in protected areas.

15.5. Safety during maintenance

- All checks and/or maintenance of the generator set must be always carried out by specialized personnel.
- Maintenance operations must be done when the engine is not working.
- Before operating any components of the electrical installation, disconnect the poles from the battery.
- Before opening the electrical panel, specialized personnel must take the following precautions:
    - Stop the generator set if it is in operation, and set the electric panel in the LOCK position.
    - Disconnect the battery/batteries from the generator set.
    - Disconnect the power input.
    - Periodically check both the tightness and insulation of connections.
- The different operations and/or maintenance procedures which are not specifically indicated in the user handbooks must be notified to the manufacturer for their approval.
- Do not carry out modifications of the product without having the knowledge and exclusive authorization by our technical department.
- Follow the recommended manufacturer's directions concerning oil changes and fuel replacements. Do not use oils or fuels that are not specified by the manufacturer.
- Spare parts must conform to the manufacturer's standards. Use original

spares only. For spares, contact original spare suppliers only, or workshops in the HIMOINSA assistance network. For a correct determination of the spare parts always refer to the data indicated on the plate of the set, the type of engine and/or alternator and their respective registration numbers.

- Periodically control the condition of the different components of the G.S., especially of antivibration components, the origin of eventual vibrations and/or the increase in noise.
- Periodically check if there are any water, oil, fuel and/or acid leaks in the battery/batteries.
- Do not modify the engine or other components of the generator set to obtain performances different from those specified by the manufacturer.
- Do not operate the fuel tank or fuel supply conduits when the engine is hot or in operation.
- Wear protective gloves and goggles:
    - When using pressurized air;
    - During battery maintenance;
    - During the supply of inhibitors or antifreeze products;
    - During the replacement or supply of lubricant oil (hot engine oil can cause scalds during emptying). Allow the oil to cool below 60º C.
- Wear protective helmets when operating in an area with suspended loads or equipment at head level.
- Always wear safety footwear and tight clothes.
- When working with parts that may be live, always make sure that your hands and feet are dry. We recommend the use of insulating flooring to perform maneuvers.
- Wet clothes must be replaced immediately.
- Keep used rags in containers that are anti-flammable or indicated for such effect.
- Do not leave rags on the engine.
- When starting up an engine that has been repaired, take precautions in order to prevent air suction in case there is an excess in revolutions during the start up.
- Always keeps the engine clean, removing eventual oil stains, gas oil and/or other cooling liquids.
- Never start up the engine when the fan speed regulator lever has been dismantled.
- Do not carry out tasks that need the presence of several people if you are alone, especially when moving or operating parts such as switches, section switches, fuses and/or other live devices.

Engine cooling circuit

- Never add coolant to a hot engine; allow the engine to cool down first.
- Periodically check the level of the coolant, and if necessary, add product until the appropriate level is reached. Only use liquids that are recommended in the use and maintenance handbook.
- Remove the radiator cap gently. The cooling conduits are usually pressurized, and therefore the hot liquid may spout if pressure is released very quickly.
- Periodically check the tightness and level of wearing of pump belts/fan.

Lubrication circuit.

- Periodically check the level of the oil in the crankcase, with a cool engine, and add oil whenever necessary, according to the directions found in the use and maintenance handbook.
- Do not smoke or light fires during the oil supply.

Fuel circuit

- Do not smoke or light fires during the fuel supply.
- Do not smoke during the fuel replacement, and be careful not to spill fuel on the generator set.

Exhaust circuit

- Watch the exhaust circuit, and in the event that any eventual gas leaks are detected, repair immediately. These are possible fire sources.
- Warning: very hot surfaces. Pre-assembled installation parts are protected against accidental contacts. The installer must insulate and/or protect any other additional parts, gas evacuation pipes, the silencer which is supplied separately, etc.

Electric start system

- Disconnect the negative pole from the battery/batteries before operating the engine, in order to prevent the automatic start system of the engine from starting while being operated.
- Keep joints tight and check that the insulation of the wires is satisfactory.
- We recommend connecting first the positive pole to the battery, and next the negative pole (usually grounding), in order to prevent the formation of electrical arches.

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Synchronous Generator.

- Do not manipulate the generator when it is in operation. Before manipulating, set the generator to the position of LOCK.
- Ensure the air intakes for the ventilation of the generator are clean, and in some models, lubricate the bearings. Also, make sure that the tightness and the position of the electrical connections are correct.

Control panel

- Before operating the control panel, disconnect the power input and set the generator to the position of LOCK.
- Electrical control panels, as all electrical devices, are damp and dusty. Verify that the anti-condensation heaters, if available, are in good working order and that the air ventilation intakes are clean.
- Periodically check that the bolts that fix electrical connections are securely screwed.

15.6. Environmental safety.

- Do not start a G.S. in closed premises, where there is no exhaust installation with outlets.
- Exhaust gases are harmful and may be lethal.
- Follow the rules and other regulations concerning acoustic installations.
- Replace the exhaust and/or silencer of the engine if the humming level is louder than the allowed by the respective regulation.
- Maintenance operations (oil replacements, fuel tank cleaning, radiator cleaning, washing, battery/batteries replacements, etc.), storage and waste disposals will be carried out according to the existing regulations in the country where they are being used.

15.7. Safety stickers and information.

There are some safety stickers and information all over the generator. Next you can find a brief explanation of their locations and information on each of them:

PICTURE	LOCATION	INFORMATION
	Located on the connections from the alternator to the engine. Whenever there are timing belts or transmission shafts.	They warn of the danger in case an alien object collides with the timing belts or with the components in motion that they connect.

DIBUJO	UBICACIÓN	INFORMACIÓN
	Located on the parts of the genset that heat up during operation.	They indicate those areas which must not be touched while the set is in operation or shortly after having stopped.
	Placed on the coolant tank cap.	They warn of the precautionary measures to be taken when opening this cap. The liquid is hot and may spout and cause scald.
	Located on the bonnet and next to the lifting eye.	It indicates the point by which the set must be lifted in order to move it.
	Located next to the fuel cap. Depending on the model, it can be either on the bedplate or next to the engine.	It indicates the location of the fuel tank. Tank filling cap.
	Located on both sides of the bedplate skids.	It indicates the advisable area to move the set by means of a fork-lift truck.
	Located next to the oil fill dipstick and oil fill cap.	Indicates the location of the oil fill dipstick.

DIBUJO	UBICACIÓN	INFORMACIÓN
	Next to the derivations of the grounding protections.	They are the parts by means of which the genset is protected against possible electric shocks.
	Next to the protective thermal-magnetic switches of the genset.	They protect the genset against possible overcurrent that may occur during charge.
	On the emergency stop.	It indicates the location of the emergency stop button which allows the simultaneous stop of the genset.
	Located on the control panel.	They warn of electric shock hazard.
	Always located on the thermal-magnetic switch.	They indicate the prohibition of manipulating the genset when the switch is on.

16. INADEQUATE USE WARNINGS

The Generator Set that HIMOINSA supplies is aimed at the production of electrical energy according to the conditions and environmental and operating limits established or agreed in this contract. All amendments of such conditions and limits must be notified directly to the manufacturer or made via authorised workshops in order to achieve an optimal performance and, if necessary, to perform modifications and/or new calibrations of the generator.

The Generator Set is a machine that transforms potential thermal energy, contained in the fuel, into electrical energy, and is aimed at supplying distribution installations that must be carried out by specialists according to existing regulations. Although the power in use is much lower than that of a public supply network, the danger of electrical energy is the same. The generator set is a production plant that, apart from the existing dangers of electrical source from a public supply network, also adds other risks derived from the existence of flammable substances (the fuel itself or lubricant oils) of rotatory parts and secondary waste products (exhaust gases and irradiation and cooling heats).

Although it is possible to take advantage of the heat contained in the exhaust gases and the cooling system in order to boost the thermal efficiency of the process, this application must be fitted by specialized

technicians to achieve a reliable installation and safe for people and things, and to prevent the expiration of the warranty.
Any other uses that have not been previously agreed with HIMOINSA shall be considered as of improper use and, therefore, they are not acceptable.

17. WORKING CONDITIONS

17.1 Standard environmental conditions for reference

- Diesel engine.
  Important: the power of Diesel engines, for stationary applications, refers to the following environmental conditions, according to the ISO 3046/1 standard:
  - Room temperature: 25º C
  - Room air pressure: 1000 Mbars (750 mm/Hg.)
  - Relative humidity: 30%
- Synchronous generator
  The environmental conditions used as a reference for alternators, stationary applications, according to the directives IEC 34-I, ISO 8528-3 and CEI 2-3, are the following:
  - Room temperature: 40°C (30°C according to NEMA)
  - Altitude: 1000m ASL (674 mm/Hg)

17.2. Derating for operative environmental conditions.

For environmental conditions of installation and operation different from those above specified, it is necessary to foresee an eventual loss of power, or 'derating', not only in the engine, but also in the generator that is fitted into it, and therefore, in the electric power provided by the generator.

The user/customer must clearly establish the effective environmental conditions in which the Generator Set will operate when placing the order. Therefore, the derating and declassification must be fixed at the time of signing the agreement, so that both the engine and the generator are correctly sized. Particularly, the user/customer must report on the following environmental conditions in which the generator set will operate:

- The upper and lower room temperature limits.
- The altitude above sea level or, preferably the minimum and maximum values of barometric pressure in the installation area; in case of mobile sets, the upper and lower limits of altitude above sea level.
- The humidity values in relation to the temperature and air pressure within the installation, paying special attention to the humidity value with respect to the maximum temperature.
- The maximum and minimum temperatures of the cooling water, only in those generators that are equipped with water-water interchangers (under special request) instead of a radiator.
- Any other environmental conditions that may require special solutions or shorter maintenance cycles, such as:
  - Dusty and/or sandy environments
  - Maritime environments
  - Environments with the possibility of chemical pollution
  - Environments with existence of radiations.
  - Operating conditions with the presence of great vibration (e.g. earthquake-prone areas, or subject to external vibrations caused by nearby machines).
- When the effective conditions are not specified in the contractual base, the power of the generator is interpreted according to the Standard conditions for Diesel engines, as established.
- If the effective environmental conditions change subsequently, it will be necessary to contact HIMOINSA, in order to calculate the new power losses and to carry out the necessary calibrations.
- For Diesel engines, these deratings are determined by the manufacturers of the respective engine. In order to become familiar with them, contact the technical department at HIMOINSA, or ask your regular supplier.
- The alternator derating is not as important as the one of Diesel engines; therefore, the general derating of the generator generator matches the derating of the engine.
- Chart 4 is a merely indicative way of determining the derating of alternators. For a higher precision, you must refer to the supplier's documentation.

Room temperature °C	30	35	40	45	50	55	60
Reduction coefficient K1 K1	1,05	1,03	1,00	0,96	0,92	0,88	0,84
Altitude - metres above sea level (m ASL)	1000	1500	2000	2500	3000	3500	4000
Reduction coefficient K2	1,00	0,97	0,95	0,92	0,89	0,86	0,83

CHART 4
Coefficients that indicate the reduction in power of an IP21 air-cooled, self-ventilated alternator, depending on the different environmental conditions.
Both K1 and K2 coefficients must be applied to the nominal power of the generator in order to obtain the power in environmental conditions that are different from the standard ones.

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Example: alternator measuring

A 64 KW (80KVA) generator set in standard conditions for an engine at 25° C, 100m ASL, 30% relative humidity (RH).

The set consists of:

- A 72kW supercharged engine at 25°C, 100m ASL and 30%RH.

- An alternator with sr = 80kVA supplied at 40°C and 1,000m ASL; being the performance of this alternator 89%.

We want to verify the maximum power that the genset can deliver at 1,000m ASL, and at a temperature of 45° C.

The derating coefficient of the engine specified by the engine's manufacturer is 0.75. Therefore, the power of the engine, under the specified conditions, will be 0.75x72 = 54kW. Considering the performance of this alternator, the power of the genset will be 54x0.89 = 48kW.

We shall verify that the alternator is the ideal one. The alternator's derating is given by two coefficients, K1 and K2, shown on Chart 4, or also found in the manufacturer's recommendations of the alternator. The apparent power is the one given by K1xK2xSR, that is:

K1=0.96; K2=0.97. The maximum apparent power will be 0.96x0.97x80 = 74,4kVA, and the active power with cos 0.8 will be: 74.4x0.8=59.2 kW. Therefore, the alternator turns to be heavily sized compared to the power that the set can offer (48kW).

17.3. Operational limits.

At the stage of placing the order, the user/customer must report on all the operative conditions that may affect the working order of the generator. Along with the environmental conditions stated above, special attention must be paid to the characteristics of the loads the generator is going to feed, the power, voltage and power factor. The connection sequence of the loads must be determined and indicated with high accuracy.

⇒ Power

The power of the generator is the active power (expressed in kW), supplied on generator terminals, to the voltage and nominal frequency and for the specified environmental conditions. Below their respective definitions can be found:

The specified features, with a ± 3% tolerance, are net and can be obtained after 50 hours of operation.

Continuous Power (COP)

It is the continuous power that the generator set can produce continuously for a limited number of hours per year, performing the maintenance intervals described by the manufacturer and in the specified environmental conditions.

Prime Power (PRP)

It is the maximum power available, for a cycle with variable power, that the generator set can produce for a limited number of hours per year, performing the maintenance intervals described by the manufacturer and in the specified environmental conditions. The average power produced for a period of 24 hours must not exceed 80% of the PRP.
A 10% overload is allowed for 1 hour out of 12 operating hours.

Stand By Power (SBY)

It is the maximum power which, in the established environmental conditions, the generator can produce for a maximum period of 500 hours per year. The load factor must not exceed 90% of the SBY.
Overloads are not allowed.

⇒ Rate

HIMOINSA generators are prepared to work at 1,500 rpm or 1,800 rpm at a rate of 50 or 60 Hz, respectively.
Low-power engines are equipped with a mechanical rpm regulator, installed in the injection pump; this is normally adjusted so that motionlessness is 5% and therefore the output rate is 52.5 Hz with no load, and 50 Hz at full load.
In static conditions, the mechanical rpm regulator usually provides an accuracy of ± 0.5%.

⇒ Voltage

The voltage regulator is usually ELECTRONIC with features that can control the voltage of the terminals.
For supercharged engines, it is possible to apply an instant voltage equivalent to 80% of the nominal voltage with a transitory fall in speed within 10%.
The specified values, for both naturally aspirated engines and supercharged engines, may vary, as usual, depending on the type of speed regulator and the generator used.

⇒ Power factor

The power of generators is the active power, expressed in kW, produced by the terminals of the generator. The nominal power factor is cos =0.8; therefore, the apparently nominal power will be 1.25 times the Nominal Active Power.

The power factor is a piece of information that depends on the characteristics of the load; HIMOINSA generators, equipped with an alternator, can produce both the active power and the reactive power required by the load but, whereas the active power is produced by the Diesel engine (transforming mechanical power into electric power by means of the generator), the reactive power is produced by the alternator.
Therefore, for a performance with values different from cos =0.8 we must consider:

Cos 0.8 <> 1 load.
The alternador works perfectly at active nominal power with the cos values between 0.8 and 1. In order to prevent engine overload, it is required not to exceed the active nominal power.

Cos < 0.8 load.

The alternator, for a certain plate value with reference cos = 0.8, overloads more when the cos value comes closer to 0. Therefore, the reactive power to be produced increases as the cos decreases. The generator reduces its power according to the directions provided by the manufacturer.
For reference purposes, Chart 5 is presented so as to determine these reductions in power. For a higher accuracy refer to the documentation provided by the generator's manufacturer.

Power factor cos	1	0,8	0,7	0,6	0,5	0,3	0
Coefficient of reduction	1,00	1,00	0,93	0,88	0,84	0,82	0,80

Chart 5. Coefficients that indicate the reductions in power for a generator in a cos function.

⇒ Single-phase loads

The generators may be supplied with unbalanced loads that can reach the nominal current of each phase. This means that between two phases (for example, L1 and L2) you cannot insert more than 0.58 of the three-phase nominal power of the set: similarly, between one phase and the neutral (eg. L3 and neutral) you cannot insert more than 1/3 (that is, 33%) of the three-phase power of the plate.
It is necessary to take into consideration that during the single-phase operation, or with unbalanced loads, the voltage regulator cannot hold the expected voltage tolerances.

⇒ Charge intakes

When a charge is applied to a generating set, a series of transitory variations of voltage and frequency occur. The scope of such variations depends on the value of the power, both active (kW) and reactive (kVAR) of the variations of the load, depending on the characteristics of the diesel engine and alternator.

When charge intake capacity constitutes an important requirement, the customer/user must

$$\sqrt{3}/3=0.58$$

clearly specify it and must provide HIMOINSA with all the necessary information related to the different loads to feed, it's possible distribution in groups and the connection sequence. The former is necessary to obtain the best dimensions of the generator and to prevent low-profit oversized generators or dangerously downsized ones.

⇒ Start-up of asynchronous engines

The start-up of asynchronous engines by means of a generator set poses some problems, as engines with squirrel cage motors have start-up voltages that are 8 times higher than the normal intensity of the generator (Iarr = 8 x In), and a low power factor.

In these conditions, the current that is absorbed by the asynchronous engine (or by the engines that start simultaneously) during the start-up, must not exceed the maximum current that the generator can produce in short times, taking into account a tolerable fall in voltage and without exceeding overheat limits.

In order to avoid this excessive oversize of the generator, the following systems can be used: Several engines: distribute them in several groups each, according a pre-set sequence, at time intervals of 30-60 seconds.

One engine: whenever the operating machine that is fitted allows it, by using a startup system with reduced voltage (star/triangle or self-transformer), or, for higher powers, single-coil rotor engines and rheostat starters. For star/triangle startups, the voltage of each phase turns out to be reduced and the startup voltage (Iarr) decreases in the same proportion.

$$1/\sqrt{3}=0.58$$

It is evident that, in the case of an engine with Iarr=6 x In in direct startup, with a star/triangle startup, it reduces approximately up to 3.5xIn, and as a consequence there is a power request to the generator which is lower than a 6/3.5 ratio.
In all cases, both direct startup and reduced voltage startups, it is necessary to control the devices and equipment that are connected to the circuit in use in order to avoid failures (eg. the opening of contractors) due to a transitory fall in voltage at the time of startup.

18. GENERAL DESCRIPTION

The sets are used for two main types of services:

Continuous service sets: Used for the production of electrical energy in areas where there is no other

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source of production and application for several purposes (motion force, lighting, heating, etc.)

Emergency service sets: They are used to solve energy interruptions that may cause serious problems to people, physical and/or financial damage (hospitals, industrial facilities, airports, etc.) or to face consumption peaks.

Depending on the assigned destination, the sets are subdivided into:

Sets for terrestrial use
Sets for maritime use

The sets for terrestrial use, depending on the use they are aimed at, have been provided with two types:

Static sets (for fixed installations)
Mobile sets (for mobile installations)

Both types can be subdivided at the same time into a wide range of models depending on their variety and user demands:

Manual operation generators
Automatic operation generators
Continuity sets

18.1. Diesel engines

They operate with a four-stroke diesel cycle, naturally aspirated direct injection, turbocharged and/or aftercooled. The layout of the cylinders depends on the engine model, and it can be in-line or V-type. It is a water-cooled type of engine.

18.2. Monopalier alternator

Generator with a horizontal shaft, synchronous without brushes, auto excited and auto regulated. The alternator has an automatic voltage regulator. This regulator has got potentiometers in order to adapt the functioning to the different conditions in which the set is used.

18.3. Coupling joint

It is possible to use two-bearing alternators upon request. The engine and the alternator are joined by means of elastic coupling and through a hood coupling in order to guarantee a correct coaxial position of the assembly.
For standard assemblies it is possible to use single-bearing alternators, and the connection is made by means of flexible disks that are fixed directly to the engine wheel.

18.4. Support bedplate

The support bedplate or base consists of a folded metal sheet with a suitable stiffness, which holds the generator set by means of elastic supports (silentblocks) that remove the transmission of vibrations to it, and therefore, to the ground. The fitting to the foundations is usually made by means of long bolts with nothing in between.
The fuel tank is located on this support bedplate which, depending on the model, is equipped with a filling hole, a flow meter (one or two signals), an emptying hole and a vent, and it is connected to the aspiration pipes of the injection pump by means of flexible elements, and fuel returns from theinjection pump and the injectors drain.
Due to the specific needs of our customer, we can supply high capacity tanks separately. However, in this handbook we shall only describe the fuel tanks that are fitted into the supporting base. Moreover, inside the supporting base it is possible to find a suitable housing for the battery/batteries with its respective fixing iron fittings.

18.5. Soundproof bonnet

Depending on our customers' demands and applications, the generator may be equipped with a protective soundproof bonnet. Such bonnet is made of steel sheets of a suitable thickness, accordingly treated in order to allow a perfect finish.
The bonnet is internally covered with a fireproof, sound-absorbing material classified as M-0 material. In air intakes and outlets, the bonnet is equipped with its respective piping, designed for driving air without producing the logical reverberations of a forced air drive.
The engine exhaust is silenced using a high-performance noise-reduction silencer that guarantees a correct noise reduction level.
The bonnet is equipped with perfectly soundproof doors covered with fireproof fiber.
The locks are supplied with keys that prevent an improper use by unauthorized personnel, even in the control area of the generator.

18.6. Electrical panel with manual start

The HIMOINSA electrical panel is designed to bring together the electrical control equipment, the general protections of the engine and alternator, the alarms and measure and control equipment.

18.7. Electrical panel with automatic start

The automatic panels are connected to the power supply and to the set. When the electrical supply is suitable the power supply contactors are locked and the supply to the sets comes from the power supply.
When the electric supply is poor the power supply contractors unlock and the generator starts automatically. The generator contactors detect voltage in the terminals and switch in order to make use of the generator.

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Please contact our commercial department to find out about the possibilities that our control systems can offer.

18.8. Control and protection controller

Specific handbooks and electric diagram are supplied belong each control panel.

19. INSTALLATION

19.1. Important warnings:

When the generator is delivered it is advisable to check that the received material matches the order, and to compare it with the delivery note that is enclosed with the set. Also, check that the material is not damaged. Proceed to open the packaging.

In case any flaws are detected, you must contact the shipping company immediately in order to report the incident to the insurance company.

“Himoinsa specifies that all deliveries are made at the customer’s complete risk”

During the operations prior to the installation of the automatically-driven generators, or when connecting the electrical connections, or in order to avoid unfortunate startups, etc. the following precaution measures must be taken:

Battery/batteries must be disconnected.

The control panel switch must be set to the OFF position.

Safety rules for diesel G.S.

The engine room and installations of the set (foundations, air intake, gas exhaust) must match the “Safety rules” that exist in the country where the generator will be installed.

Installation

For stationary generators, two types of installation can be considered:

Outdoors assembly

Indoors assembly

19.2. Outdoor installations.

The generators which are assembled outdoors (excluding soundproof sets, that are intended for such applications), must be located in a place which must be as protected against weather conditions, dust, etc. as possible.

For temporary installations, the generator can rest on a well-levelled surface. For long-time installations, it is advisable to build a concrete base.

19.3. Indoor installations

- Generator room

  For the correct installation of a generator in closed premises, the size of the room must allow:

  - The regular operation of the generator.
  - An easy access to its components for maintenance and possible repairs.
  - The possibility of introducing the generator using the available means of transport. The door through which the generator will be introduced must be centered, so that the set remains centered once it is inside, and there is no need of moving it.
  - The existence of holes that allow oil replacement.
  - The installation of the exhaust pipe with the minimum possible number of pipe elbows.
  - The generator to be placed in the middle of the premises, with respect to perimeter walls, in order to facilitate access.
  - The layout of the command panel (in case it is an automatic set) to be in a position that allows the operator to have complete visibility over the instruments when operating it.

  The recommended room dimensions are displayed in the following pictures:

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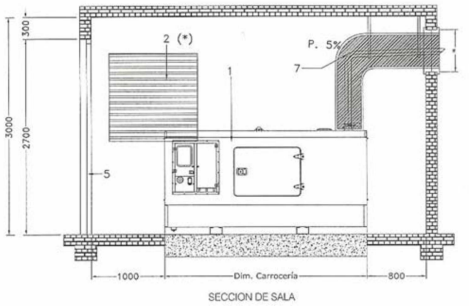
ENCLOSED GENERATOR

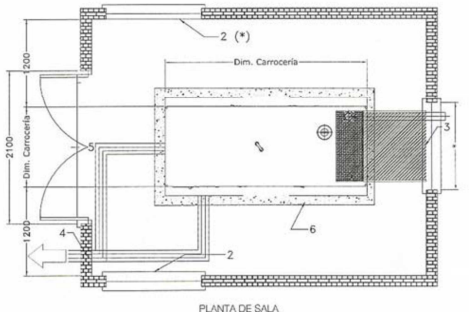
1. Generating set.
2. Control panel.
3. Air intake gap.
4. Air outlet tunnel.
5. Cable wire way.
6. Access door.
7. Reinforced concrete base.
8. Exhaust pipe.
9. Flexible pipe.
10. Exhaust silencer.

* May vary depending on the function of the outlet section of the model (see plans of the specific model to be installed).

The dimensions showed are in millimeters.



SECCION DE SALA



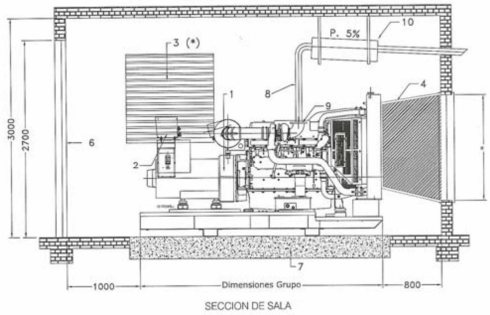
PLANTA DE SALA

OPEN SET GENERATOR

1. Generating set.
2. Control panel.
3. Air intake gap.
4. Air outlet tunnel.
5. Cable wire way.
6. Access door.
7. Reinforced concrete base.
8. Exhaust pipe.
9. Flexible pipe.
10. Exhaust silencer.

* May vary depending on the function of the outlet section of the model (see plans of the specific model to be installed).

The dimensions showed are in millimeters.



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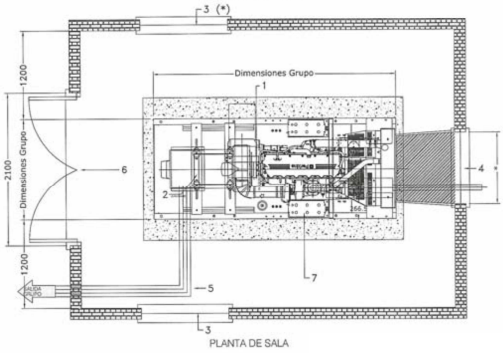


PLANTA DE SALA

The basic elements to be considered are:

- Foundations
- Exhaust installations
- Ventilation
- Fuel installation.
- Electrical connections
- Grounding.
- Heating

⇒ Foundations

The foundations must be calculated and dimensioned by experts in civil engineering. They must prevent the transmission of vibrations and noise to other parts of the building. The surface on which the set will be placed must be leveled in order to allow its correct operation. For cleaning reasons, it is

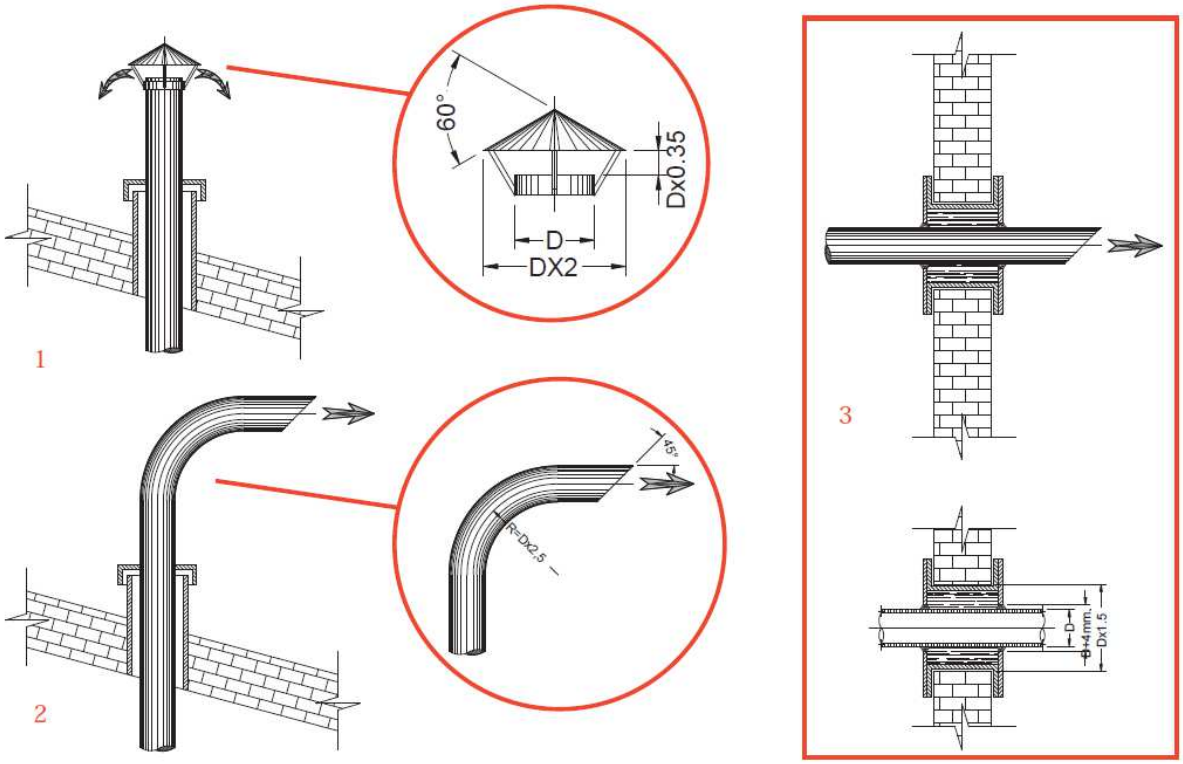
oundations are approximately 10cm above the floor level, and covered with gres industrial sandstone tiles.

⇒ Exhaust installation

Exhaust outlet pipes

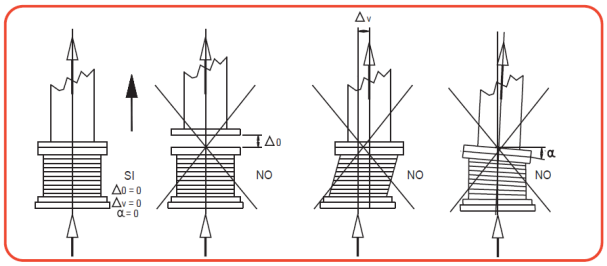
The outlet pipes for exhaust gases are usually made of flat steel, with no welding, or in other special cases, with asbestos-concrete pipes.

The pipes must evacuate the gases to those areas where they cause no danger or damage, and must end with a protection cap to protect them from water entry, or with a similar system. (1) and (2)



In the part where they run through the walls, it is recommended to perform a thermal insulation of the pipes, in order to prevent heat expansion to the walls. (3)
The joints between the different pipe stretches must be perfectly sealed, so that there are no gas leaks. The connection between flange and gasket is the most ideal one. It is also recommended to place a condensation collector, with faucet, on the bottoms point of the pipelines.

The connection between the engine's collector outlet (or the turbo blower exhaust for supercharged types) and the pipe must be made by means of a stretch of flexible tube, so that the actions induced by the engine and the thermal expansions of the pipe are absorbed by the engine without damaging any elements.



The use of flexible element also demands the placement of flanges in the exhaust pipe, independent of the generator. Therefore, the pipelines must be fixed to the walls or ceiling of the engine room, with supports that can bear the weight of the pipe to the engine outlet, so that it does not rest on the parts of the engine (collector, turbo blower), and allow its expansion.
When dealing with very long pipes, it is necessary to insert expansion joints made of sealed flexible elements.
When establishing the trajectory of the exhaust pipe, it is necessary that the pipe is not near the engine air filters, in order to prevent the machine from drawing in hot air. Otherwise, it will be necessary to insulate it.

Whenever there are several generators, it is advisable that all exhausts do not converge on a common pipe, as there can be problems when some generators are in operation and others are not. The produced exhaust gases can penetrate in the conduits of the sets that are not in operation and may cause damage.

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A. Exhaust pipes measurement for Standard Static Generators

The engine's exhaust backpressure has a remarkable influence on the produced power and on the thermal charge.
Excessive backpressure values (measured at the exhaust collector outlet for turbocharged engines, and at the turbine outlet in case of supercharged engines) cause reductions in power, rise in temperature of exhaust gases, fumes, high fuel consumption, cooling water overheat, lubricant degradation, and the ensuing consequences on the engine parts.

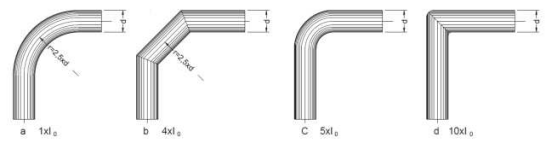
The limits that must not be exceeded (referred to the delivery conditions of maximum power at full throttle) in HIMOINSA genets must be consulted in the factory.

Such limits can be observed considering the dimensions that are suitable for the exhaust installation, that is, the diameter of the pipe and type of silencer.

The pipes must be as short as possible, and with as few pipe elbows as possible. Whenever these are essential, they must be used with a very wide angle of curvature (from 2.5 to 3 times the diameter of the pipe).
Solutions with bends of angles lower than 2.5 times the diameter pose difficulties so they must be avoided.

In order to calculate the total length of the pipe (which is crucial for the exhaust's backpressure), the following considerations must be taken into account:
The rectified length of the pipe elbows must be determined according to the chart and pictures:

Interior diameter of the exhaust pipe (mm)	40	50	65	80	100	125	150	200	250	300
Equivalent rectified length Lo	0.5	0.7	0.9	1.2	1.7	2.2	2.8	4.0	5.4	6.7



The backpressure values due to the exhaust silencers may vary within a wide range, depending on the type of building, dimensions and noise abatement characteristics:
- If it is the one supplied by HIMOINSA, the length must be multiplied by a coefficient of safety, so that the total length to be considered due to backpressure will be: L=2xl.
- If it has been provided by another supplier, it is recommended to check the value of backpressure derived from the silencer with the supplier.

Example: The exhaust pipe consists of the following parts:

- 5 metres of straight pipe stretches.
- Two pipe elbows type a)
- Three pipe elbows type c)
- A 1m long silencer.

If the inner diameter of the engine exhaust is 80mm, the total length of the exhaust pipe is calculated as follows:

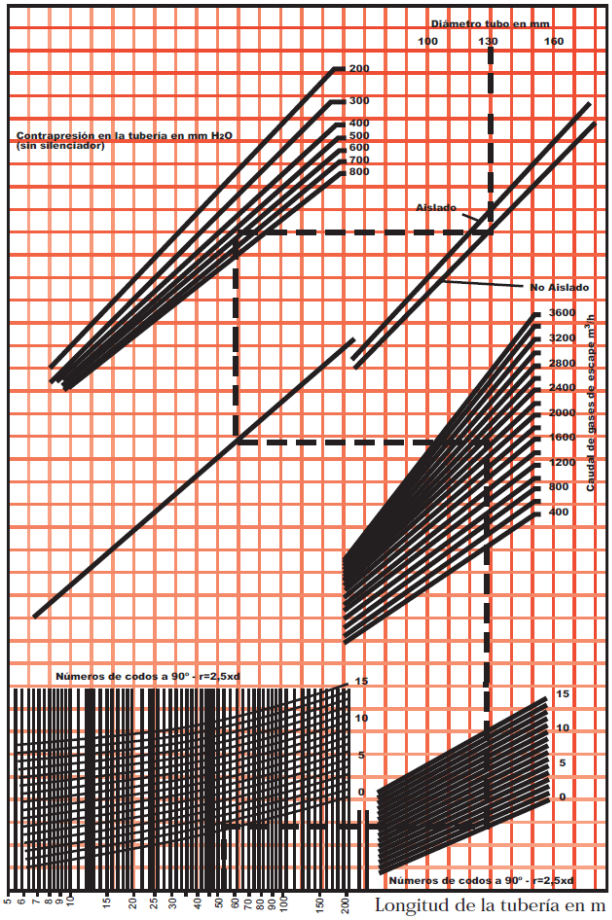
a) for the inner diameter 80mm, according to the chart, l=1.2m.

b) total length of the pipe elbows type a) is, 1X l=1X1.2=1.2m.
as there are two pipe elbows, 2 x 1.2=2.4m.

c) the total length of the pipe elbows type c) is 5 X l=5 x 1.2= 6m.
as there are three pipe elbows, 3 x 6 = 18m.

d) the total length of the exhaust silencer is L=2X l = 2X1 = 2m.

e) the total length of the exhaust pipe is: 5+2.4+18+2= 27.4metres



In order to calculate the diameter of the exhaust gases pipe it is possible to use the nomogram that can be found below:

- For calculation purposes, in this nomogram we will use the following backpressure values:
  - 800 mm H2O, for aspirated engines.
  - 400 mm H2O, for supercharged engines.
- Exhaust gases airflow in kg/h. In order to convert into m3/h, the data must be divided by the exhaust gases density. Request these data to the manufacturer.

silencer can be altered, by reducing the length of the

Example: If we take the exhaust pipe from the previous example, with a total length of 27.4 metres (taking into account the rectified length of the pipe elbows and the length equivalent to the exhaust silencer). From the following data of the installation:

- 5 pipe elbows at 90º (2x type A and 3x type C).
- Set model: HIW-210
- Working rate: 50 Hz
- Motor: 8361 SRi 26 (supercharged).
- Insulated pipe.

a) Start from the lower part, with a total pipe length of 27.4m (straight stretches + rectified elbow length), until crossing the straight line relative to the total number of pipe elbows in the installation (5 elbows).

b) Continue and follow a horizontal direction to the right until crossing again the straight line relative to the number of pipe elbows (5 elbows).

c) Continue upwards until crossing the straight line relative to the flow of the exhaust gases, which according to the chart is 1120 kg/h. To convert kg/h into m^3/h divide the flow expressed in kg/h by the density of the exhaust gases. As a first approximation we can take the density of the exhaust gases with a value of 0.42 kg/ m^3

1120x0.42=2667 m $^3/_h$

d) Continue horizontally to the left. After crossing the straight line, continue upwards until crossing the straight line relative to the overpressure of the pipe, 400 mmH_2O.

e) Continue upwards until crossing the straight line.

f) Continue to the right until the straight line relative to the insulated pipe. After crossing this last straight line, the pipe diameter, 122 mm, is determined on the right top part. The commercial diameter right above is the one to be considered.

The exhaust pipe cannot have a lower diameter than the collector pipe of the engine exhaust, and also, the straight stretches must have a slight inclination in order to prevent the return of condensates, as shown on the location plan of the generator in the room.

When the diameter of the pipe is higher, the engine joint must have a conic connection element with a conicity below 30º in order to avoid excessive load losses.

B. Exhaust pipes measuring for Soundproof Static Generators

Check with the HIMOINSA engineering department. There is backpressure in the outlet of the generator which is caused by the internal pipes. It is necessary to know this value so as not to exceed the recommended backpressure when designing the rest of the installation.

⇒ Exhaust silencer

The exhaust silencer is usually attached to the stretch of pipe that remains inside the room where the generator is located. Whenever possible, it can be separated from the generator.
The silencer used in industrial applications performs a 15 to 20 decibels noise reduction.
In order to reduce the noise caused by the resonances of gas pulses in pipes, the position of the tube that goes into the engine. For example, for a 10m long pipe, the optimal position would be half-way through the distance in relation to the outlet.

In the cases of private installations, such as hospitals or residential areas, where a higher noise reduction is required, special silencers can be used, with a reduction of 25 to 30 decibels, and whenever possible, using special quiet chambers.

⇒ Ventilation

The ventilation of the engine room where the G.S. is installed is of vital importance for a correct operation and durability of the generator.
The engine room must have the following features:

- Allow the dissipation of the heat produced when the generator is in operation by irradiation and convection.
- Guarantee the correct supply airflow, and in the right amount for the engine combustion.
- Allow the engine cooling by means of the radiator, keeping the operating room temperature within the safety limits in order to guarantee a good aspiration of the supply air.

A good ventilation solution applicable to most cases is the one indicated in the charts of the sections of the installation, in which the engine fan draws in the cooling air from the engine room, whereas the hot air

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is expelled through the expulsion tunnel placed between the radiator and the room window.
The expulsion window must have a bigger or same size as the radiator in case of standard static generators, and bigger or same as the expulsion grid in case of soundproof sets.
We must prevent the radiator exhaust hot air from coming back to the engine room, making sure the expulsion conducts are leak-proof. Therefore, the air in the engine room is constantly renovated, and the dimensions of intake grilles must be big enough for the cooling and combustion.
In order to achieve a correct air flow, the cool air must be introduced through the grilles that are located on the lower part of the engine room wall. This wall should be the one located opposite the radiator, so that the air flows all over the set before being expelled through the fan.
Make sure there are no areas in the engine room where the air is deposited. This usually happens in rooms with several engines. In those cases, and whenever possible, each group should have its own air intake grille.
In case you need more details about the air flow required for the different types of HIMOINSA generators, please refer to the manufacturer.
For safety reasons, in those premises where there are sets in continuous operation, or in those areas where the room temperature is high, it is advisable to use an auxiliary extractor fan that has enough power to achieve suitable ventilation. Such extractor fan must be located on top of the room, as close to the radiator as possible.

⇒ Fuel installation

Generator sets supplied by HIMOINSA include a complete fuel installation, since the fuel tank is located on the bedplate of the generator.
The fuel tank is connected through flexible tubes in order to guarantee their operating durability, depending on the model. For longer durability, and in order to satisfy special demands, it is necessary to use a special tank that is fitted separately. It will be necessary to connect the engine to the new tank, and previously perform the placing of the flexible connections and new suitable pipes that must be firmly fixed. The new fuel tank must be located according to the following criteria, so that the engine injection pump is able to draw in fuel from the new tank:

- Closer than 20m from the engine, in case they are both at the same level.
- Less than 5m deep.

The usual connections are:

- For fuel injections to the engine injection pump.
- For fuel excess returns from the injection pump.
- For drain return of the injectors.

The pipes must not have any welds. They can be made of steel, iron or cast iron. Galvanized steel pipelines must not be used.
Flexible connections must be fitted in order to isolate the static parts of the plant from the new fuel tank, in order to avoid the possible vibrations caused by the engine. Depending on the type of engine, these can be made using the following:
Stretches with a suitable length made of reinforced rubber pipes with flexible insertions that are resistant to gas oil. For the connections with the terminal rubber holders with edges and screw clamps.
Flexible low-pressure type tubes, suitable for gas oil, protected with metal mesh and with screwed terminals for tightly-sealing.
Synthetic resins must be avoided.
In complementary areas of the plant, maximum attention must be paid to the following issues:

- Fix pipes by means of holders, at regular intervals in a way that vibrations and inflexions caused by pipes weight are avoided, especially those made of copper tube.
- Couplings must be avoided. In case of using them they must be tightly-sealed, especially in depression conditions parts (fuel aspiration intake), in order to avoid air filtrations that make the startup more difficult.
- Aspiration pipes below the fuel level must be placed at a distance of 20-30mm from the bottom, in order to avoid a possible deactivation of the circuit due to air insufflations. Also, these must be conveniently separated from each other, in a way that the fuel return flow does not block the supply due to the gas oil impurities from the bottom of the tank or mixed air.
- Thorough cleaning of the used pipes.
- Avoid abrupt variations in the tube section and the use of elbows with wide angles in pipes.

⇒ Electrical connections

The generators are ready for user connections.
When making the connections, you must comply with the conditions specified in the diagrams enclosed with the generator.

Generator of manual intervention

The user cables must be connected to the line terminals which, for standard static generators, are located inside the electrical panel, on the rail terminals or at the bottom of the magneto thermal switch, either inside

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the panel or in the molded box (check the electrical diagrams included in the manual of the panel). For soundproof sets, the connection to the grounding terminals is easily accessible, as they are prepared for such effect and protected with a methacrylate sheet.

Generator for automatic intervention

The cables that come from the generator, the external power supply and user shall be connected to their respective terminals, located in the command panel. The power cables of the generator shall be connected directly to alternator terminals of the generator.

The connection to auxiliary services between the set and the command panel shall be made with a multiple cable and using the multiple connectors plugs provided with the set.

Cable dimensions

The choice and dimensions of the cables is responsibility of the person who carries out the installation.

Cable positioning

Power cables, for both manual and automatic sets, must be placed in suitable channeling, tunnels or protective conduct-holder. Do not include 400V and 12V (or 24V) cables in the same channeling.

⇒ Grounding

Metal parts of installations which are exposed to human contact, and due to an insulation flaw or other reasons, may get in contact with voltage, must be connected to land-dispersion device. The generators and panels have been equipped with their respective grounding terminals. The connection of these to the land-dispersion must be made with bare copper wires conductors with a minimum section of 16mm2, or if not available, galvanized iron with a 50 mm2 section. The resistance of such conductor, including the contact resistance, must not exceed 0.15 Ohm.

⇒ Heating

For automatic start generators, the engine room where they are installed must be conveniently conditioned during the cold season, in a way that the room temperature is not below 10-15º C, a required condition for a quick engine start.

Electric heaters with thermostatic controls ranging from 500 to 1500W, depending on the generator, have also been supplied with those sets. They maintain the water temperature within acceptable values in case a sudden start or power input may damage the engine.

20. BEFORE OPERATION

These operations must be performed in the following situations:

- Before the startup.
- After the installation of the set.
- After a general check.
- If maintenance operations have been carried out.
- If the set has been idle for a long time.

During these operations, make sure the set cannot be started.

Water level in the radiator In case the radiator needs water, it must be refilled with a mix containing at least 50% of coolant liquid/corrosion inhibitor Paraflu II type, and the rest with clean water.

Oil lubricant level in the crankcase

The type of oil to be used is: ACEA E3/API CF4/MIL L2104E/F for supercharged engines and ACEA E2/API CJ4/MIL L2104E/F for aspirated engines. Fill up the crankcase with oil, up to the top mark of the graduated dipstick, but without exceeding it. With the cool engine, and after a short time in operation, recheck the lubricant oil, and if necessary, add the amount that is missing.

Fuel tank level

If the fuel level is below the minimum required for the startup of the generator, it is necessary to add fuel until the tank is full.

Electrical regulations

Before starting up the generator, all electrical connections, startup batteries and earth connections must be checked. The terminals must be firmly connected and all switches must be set to their unlocked positions.

Cyclical direction of the phases

For generators intervention automatic or in those auxiliary, hand-operated ones for external production lines, make sure the cyclical direction of the alternator phases matches the phases of the external producer in order to avoid reversals in rotation and other inconveniences.

Air filter check-up

It must not have obstructions or porosities that prevent a good air filtering. In case of showing deterioration you must proceed with the maintenance operations of the air filter.

Radiator/intercooler (air/air) check-up

Verify that the surface of the radiator air intake is clean.

Checkup of the liquid level in batteries

Once the batteries are settled and cool, check that the level of liquid is between the maximum and minimum levels.

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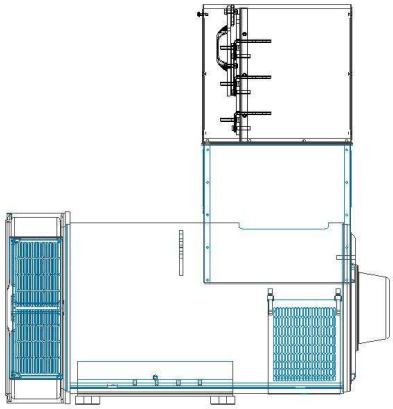
21. VOLTAGE CHANGE OVER BOARD (HRMW range)

The HRMW Rental Ready Generator Set is equipped with a two position voltage Change Over Board. This system allows the operator to quick swap from voltage to another without having to touch any of the internal wiring of the alternator. Changing the position of the copper buss bars located inside the voltage reconnect board enable the machine to operate in 277/480V (High Wye) or 120/208V (Low Wye).



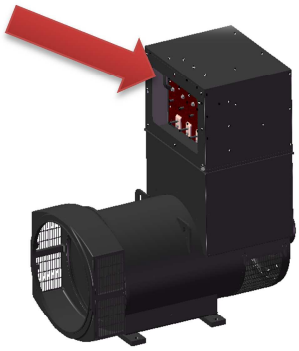
DANGER LIVE VOLTAGE.

Warning risk of electric shock! do not operate this panel without reading manual or proper training.

For use by qualified personnel only.

21.1 Locating the Change Over Board Panel.

The voltage quick reconnect panel is located on top of the generator end enclosure/ Housing. Inside this panel are the copper bonding bars as known as “jumpers” that allow the Voltage Change Over Board (VCOB) to jump the generator winding from Low Wye to High Wye.

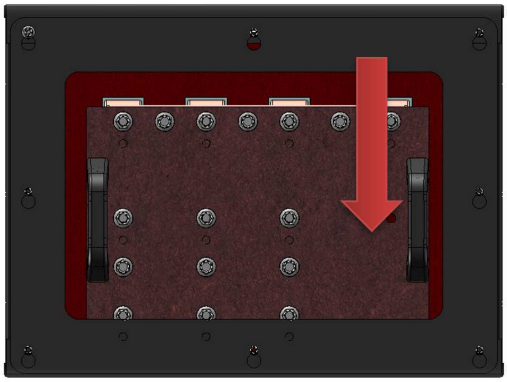


21.2 277/480V Position

When the VCOB is located in upper position the generator will operate in a STAR CONNECTION common known as High Wye.

21.3 120/208V Position

When the VCOB is located in lower position the generator will operate in a STAR PARALLEL CONNECTION common known as Low Wye.

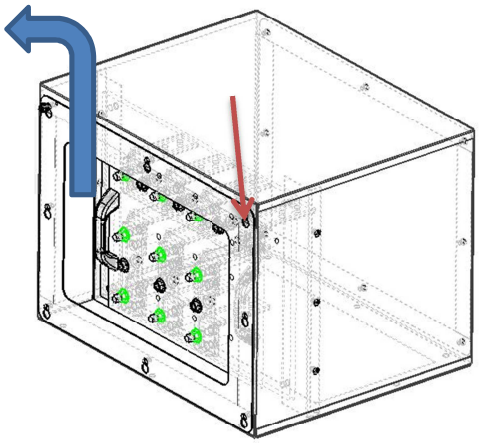


For information regarding the electrical wiring diagram of the VCOB, please see owner's manual located inside the generator set.

21.4 How to change the voltage

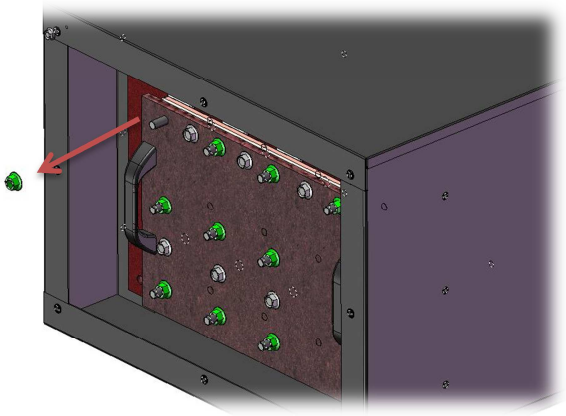
Step 1

In order to access the VCOB, loosen the six bolts the hold the access door in place, **see RED arrow in the illustration to locate BOLTS**. To remove the door, slide up about ½" follow by pulling out towards the back of the engine, **see BLUE arrow in the illustration.**



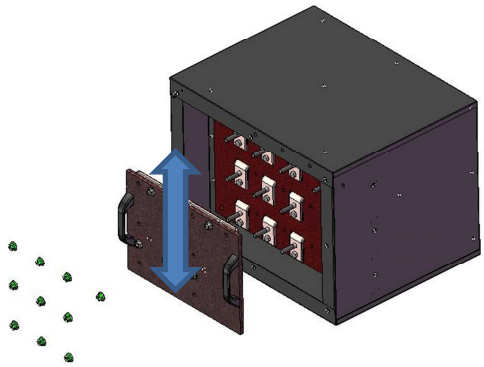
Step 2

Remove the seven nuts [shown in green color] that hold the front panel of the VCOB, see RED arrow in the illustration to locate NUTS. Do not remove the rest of bolts that hold the jumper buss bar assembly.



Step 3

Remove the jumper bar assembly, by pulling out on the two black handles, see BLACK arrow in the illustration to locate HANDLES. Reconnect the jumper bar assembly to desire voltage. To obtain 120/208V connect the VCOB in the lower position or for 277/480V connect to upper position, see BLUE arrow in the illustration.



Step 4

Assemble everything back together in the reverse sequence of the three first steps. If selecting the 277/480V position all unused nuts must be tighten back to original studs for future use, see RED arrow in the illustration to locate NUTS.

MORE INSTRUCTIONS ARE LABELED INSIDE THE CHANGE OVER BOX.

22. REAR DISTRIBUTION PANEL

The panel has three, 50 amp twist lock connectors.

It has three, 50 amp breakers for protection for the twist lock 1 phase 120/240 twist lock plugs.

The panel is equipped with two, 20 amp GFI plugs 120 volts protected by two, 20 amp circuit breakers.

DO NOT USE GFI PLUG WHEN SELECTOR IS IN 480 VOLT 3 PHASE POSITION BECAUSE THE VOLTAGE IS TOO HIGH 138 VOLTS.
The upper portion of the distribution panel is protected by the 50 amp and 20 amp breakers in the front of the panel.

The cam locks and mounting lugs are protected by the main circuit breaker by the main control panel.

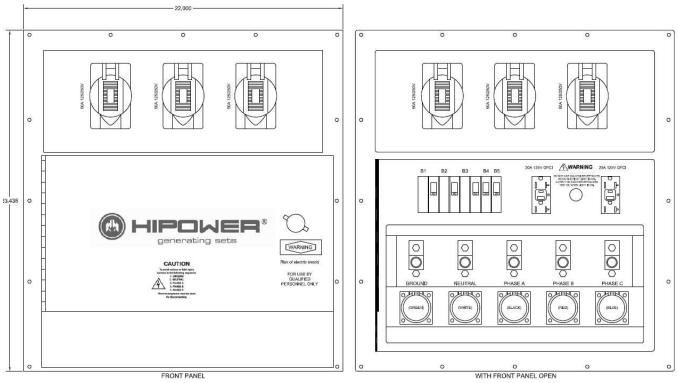
The panel has five cam lock plugs.

- ⇒ Black A phase or L1
- ⇒ Red B phase or L2
- ⇒ Blue C phase or L3
- ⇒ White Neutral
- ⇒ Green Ground

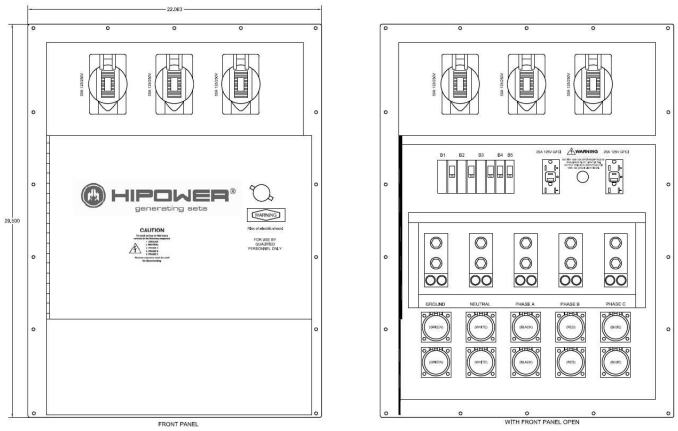
The control panel also has mounting lugs for A, B, C, & neutral and ground.

Amps and the KVA size of the generator determine the number of connections. If needed, you can also pull power from the lower panel under the circuit breaker located by the control panel.

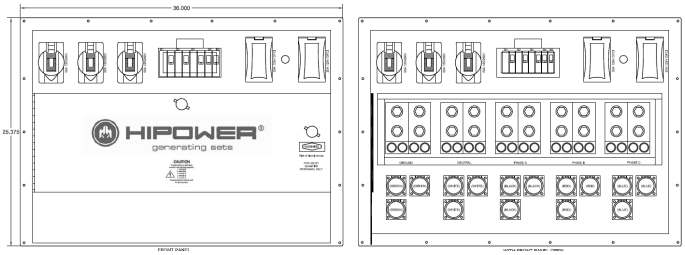
400 AMPS REAR DISTRIBUTION PANEL



800 AMPS REAR DISTRIBUTION PANEL



1200 AMPS REAR DISTRIBUTION PANEL



Task Description

Engine

Engine - Barring with starting system

Preconditions

☑External pushbutton “Bar engine without starting” is provided.

DANGER

Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Before cranking the engine with starter system, make sure that there are no persons in the engine's danger zone.

Engine – Barring with starting system

1. Press pushbutton “Bar engine without starting” and keep depressed.
2. Let the crankshaft rotate until oil pressure is indicated, but not longer than 10 seconds.
3. Repeat this procedure after approx. 20 seconds if required.

Engine - Test run

DANGER

Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Before cranking the engine with starter system, make sure that there are no persons in the engine's danger zone.

WARNING

High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Engine – Test run

1. Start engine
2. Perform test run not below 1/3 load and at least until steady-state temperature is reached.
3. Carry out operational checks
4. Stop engine

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Valve Drive

Valve clearance - Check and adjustment

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine coolant temperature is max. 40°C.

☑ Valves are closed.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Feeler gauge	Y20098771	1
Torque wrench, 20-100 Nm	F30026582	1
Box wrench, 14 mm	F30028346	1
Allen key, set 2-10 mm	F30453050	1
Barring gear	F6790714	1

Preparatory steps

1. Remove cylinder head cover (→ Page 98).
2. Remove cover on the bottom of flywheel housing, A side.
3. Install barring gear at opening.
4. Rotate crankshaft with barring gear in engine direction of rotation until "OT-A1" mark and pointer are aligned.

Diagram for 8 V engines (two crankshaft positions)

1 Cylinder A1 is in firing TDC
2 Cylinder A1 is in overlap TDC
I Inlet valve
X Exhaust valve

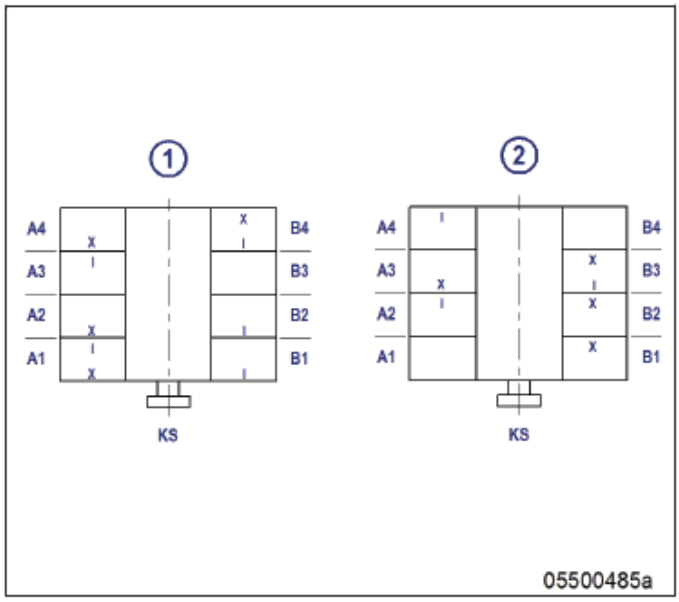

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Diagram for 10 V engines (two crankshaft positions)

1 Cylinder A1 is in firing TDC
2 Cylinder A1 is in overlap TDC
I Inlet valve
X Exhaust valve

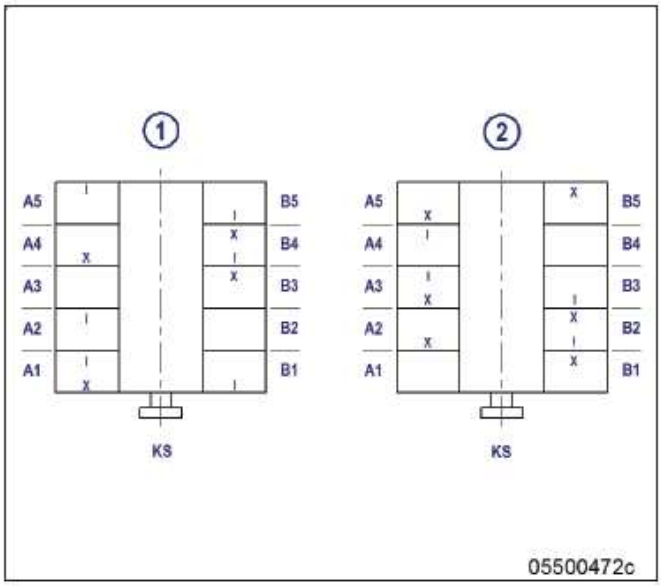
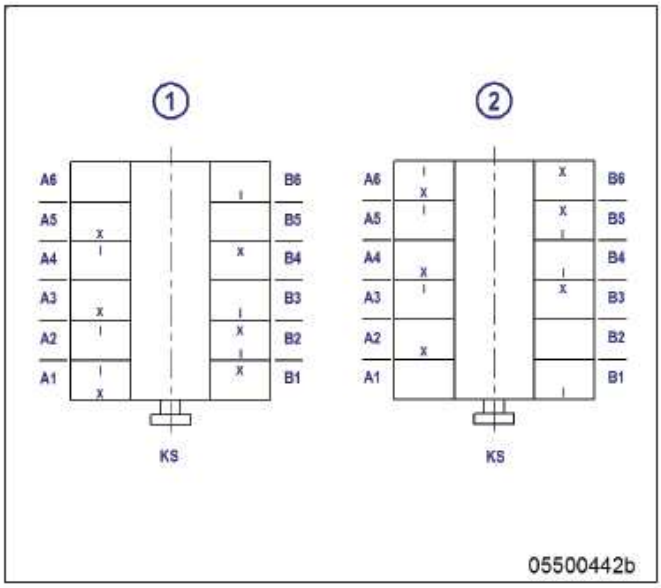


Diagram for 12 V engines (two crankshaft positions)

1 Cylinder A1 is in firing TDC
2 Cylinder A1 is in overlap TDC
I Inlet valve
X Exhaust valve



Checking valve clearance at two crankshaft positions

1. Check TDC position of piston in cylinder A1:
   - If the rocker arms are unloaded on cylinder A1, the piston is in firing TDC.
   - If the rocker arms are under load on cylinder A1, the piston is in overlap TDC.
2. Check valve clearance with cold engine:
   - Inlet = 0.3 +/- 0.05 mm;
   - Exhaust = 0.6 +/- 0.05 mm.
3. Check all valve clearances in two crankshaft positions (firing TDC and overlap TDC of cylinder A1) as per diagram.
4. Use feeler gauge to determine the distance between valve bridge and rocker arm.
5. If the deviation from the reference value exceeds 0.1 mm, adjust valve clearance.

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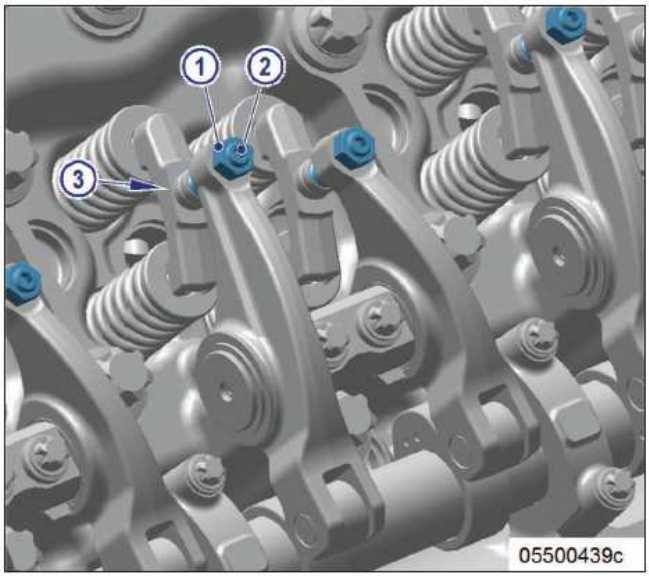
Adjusting valve clearance

1. Loosen locknut (1) and unscrew adjusting screw (2) by a few threads.
2. Insert feeler gauge between valve bridge and rocker arm (3).
3. Readjust adjusting screw (2) so that the feeler gauge just passes through the gap.



4. Tighten locknut (1) to specified torque using a torque wrench, holding adjusting screw (2) firm with Allen key (5 mm).

Name	Size	Type	Lubricant	Value/Standard
Nut	M10 x 1	Tightening torque		43 Nm +4 Nm

5. Check if the feeler gauge just passes through between valve bridge and rocker arm (3).

Result: If not, adjust valve clearance.

Final steps

1. Remove barring gear.
2. Install cover.
3. Install cylinder head cover

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Cylinder head cover - Removal and installation

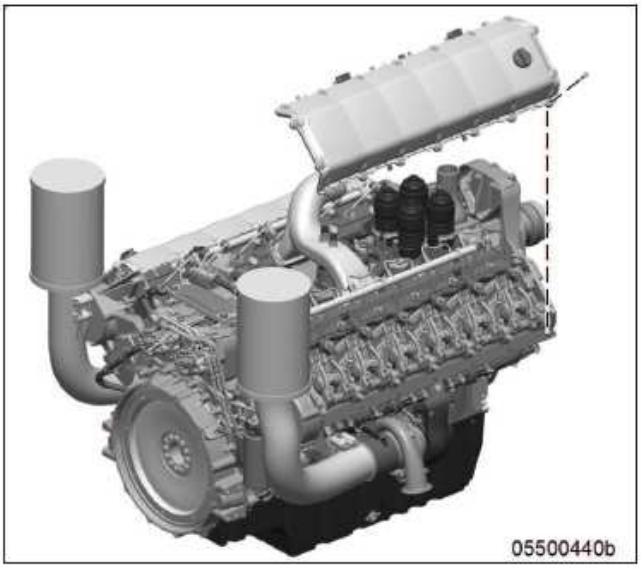
Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 10-60 Nm	F30510423	1
Ratchet	F30027340	1

Removing and installing cylinder head cover



Note: Cover the engine beneath the cylinder head with cloths to collect emerging oil.

1. Remove screws.
2. Remove cylinder head cover.
3. Clean mating faces.
4. Check condition of profile gasket and replace if required.

5. Fit cylinder head cover and tighten screws with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw with twin collar	M8	Preload torque		10 Nm

6. Tighten screws with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw with twin collar	M8	Tightening torque		20 Nm

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Fuel System

Fuel system - Venting

Preconditions

☑ Engine is stopped and starting disabled.

WARNING

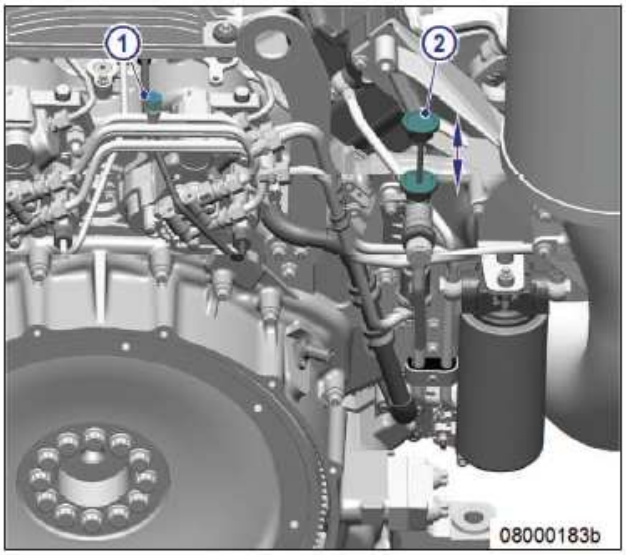
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Venting fuel system

1. Unlock fuel priming pump, screw out handle (2).
2. Loosen nut (1) on banjo union.

Note: Catch emerging fuel with a suitable cloth.

3. Operate the pump with the handle (2) until bubble-free fuel emerges.
4. Tighten nut (1) on banjo union.
5. Lock fuel priming pump, screw in handle (2).



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Fuel Filter

Fuel filter - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

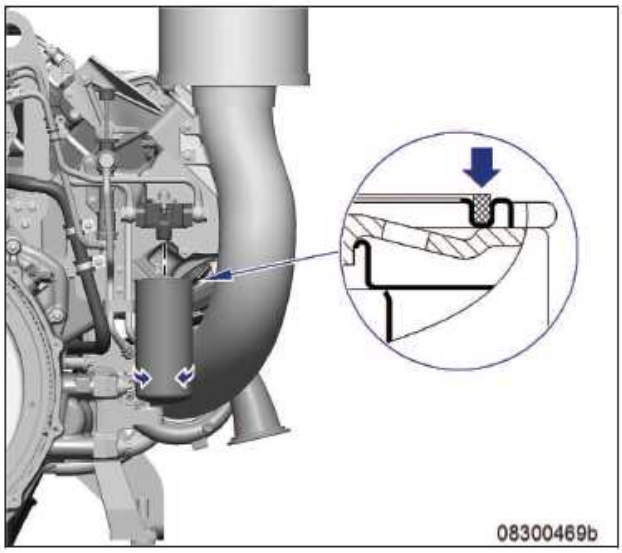
Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Engine oil		
Easy-change filter	(→ Spare Parts Catalog)	1

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Replacing fuel filter

1. Remove easy-change filter using the filter wrench.
2. Clean sealing surface on filter head.
3. Slightly lubricate seal on the easy-change filter.
4. Screw on easy-change filter by hand until the seal makes contact and then tighten by hand.



Fuel prefilter - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

☑ System is not under pressure.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Engine oil		
Easy-change filter	(→ Spare Parts Catalog)	1

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

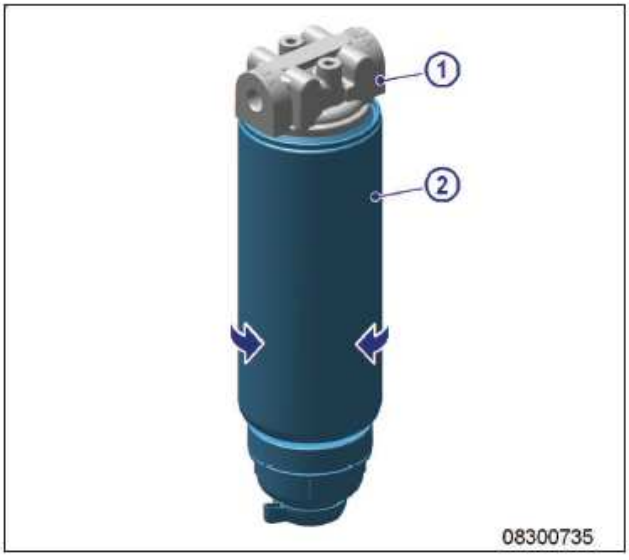
Tank is pressurized.
Risk of eye injuries resulting from fluid escaping under high pressure!
- Open tank slowly.
- Wear goggles or safety mask.

NOTICE

Contamination of components.
Damage to component!
- Observe manufacturer's instructions.
- Check components for special cleanliness.

Replacing fuel prefilter

1. Remove easy-change filter (2) with filter wrench.
2. Clean sealing surface on filter head (1).
3. Lightly lubricate seal on the easy-change filter (2).
4. Screw on easy-change filter (2) by hand until the seal makes contact with the filter head and tighten manually.



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Air Filter

Air filter - Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Air filter	(→ Spare Parts Catalog)	

Air filter – Replacement

1. Remove air filter and install new one
2. Reset signal ring of service indicator

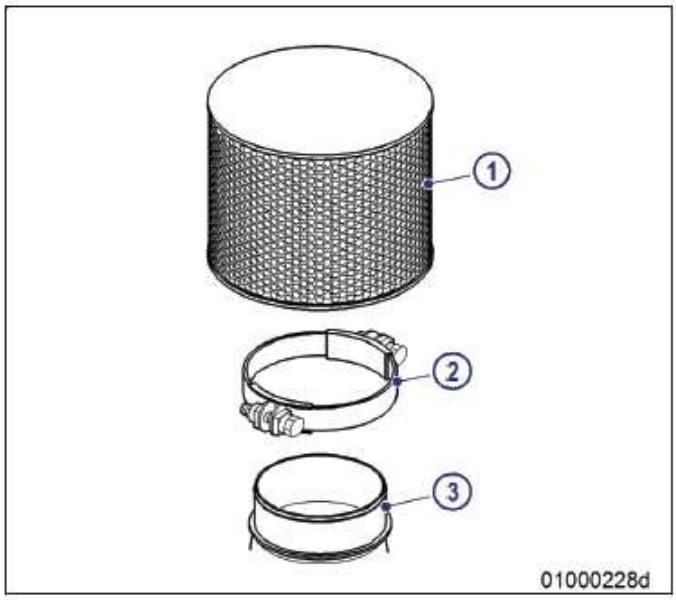
Air filter - Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Air filter – Removal and installation

1. Loosen clamp (2).
2. Remove air filter (1) and clamp (2) from connecting flange of intake housing (3).
3. Verify that there are no objects in the flange of the intake housing (3) and clean it.
4. Place new air filter (1) with clamp (2) onto intake housing (3).
5. Tighten clamp (2).



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Air Intake

Service indicator - Signal ring position check

Preconditions

☑ Engine is stopped and starting disabled.

Checking signal ring position

1. Replace air filter, if the signal ring (2) is completely visible in the red area of the service indicator control window (3) (→ Page 102).
2. After installation of new filter, press reset button (1).

Result: Signal ring returns to initial position.

Starting Equipment

Starter - Condition check

Preconditions

☑ Engine is stopped and starting disabled.

Checking starter condition

1. Check securing screws of starter for secure seating and tighten if required.
2. Check wiring

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Lube Oil System, Lube Oil Circuit

Engine oil - Level check

Preconditions

☑ Engine is stopped and starting disabled.

Checking oil level prior to engine start

1. Remove oil dipstick (1) from guide tube and wipe it.
2. Insert oil dipstick (1) into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between "min." and "max." marks.
4. If necessary, top up to "max." mark
5. Insert oil dipstick (1) in guide tube up to the stop.

Checking oil level after engine is stopped

1. 5 minutes after stopping the engine, remove oil dipstick (1) from the guide tube and wipe it.
2. Insert oil dipstick (1) into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between "min." and "max." marks.
4. If necessary, top up to "max." mark
5. Insert oil dipstick (1) in guide tube up to the stop.

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Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine is at operating temperature.

☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

Special tools, Material, Spare parts

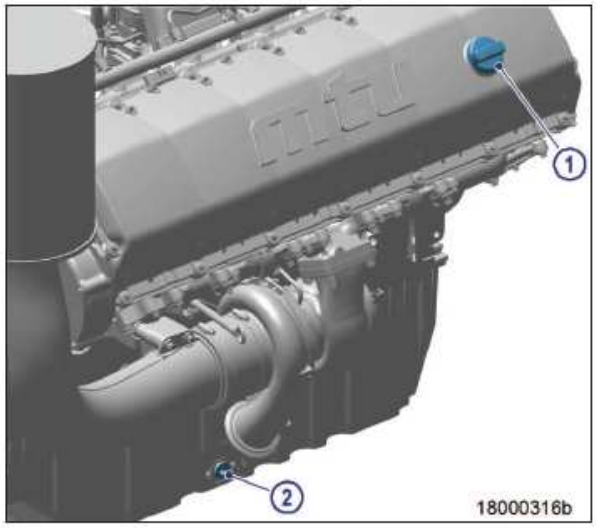
Designation / Use	Part No.	Qty.
Torque wrench, 20-100 Nm	F30026582	1
Ratchet	F30027340	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Draining oil at drain plug on oil pan

1. Provide a suitable container to collect the oil.
2. Remove drain plug (2) and drain oil.



3. Insert drain plug (2) and use torque wrench to tighten to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Drain plug		Tightening torque	(Engine oil)	100 Nm

4. Replace engine oil filter (→ Page 108).

Filling with new oil

1. Open cap (1) on cylinder head cover.
2. Fill with oil; Oil filling capacity (→ Technical data).
3. Close cap (1) on cylinder head cover.
4. Check engine oil level

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Oil Filtration / Cooling

Engine oil filter - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 10-60 Nm	F30510423	1
Ratchet	F30027340	1
Socket, 32 mm	F30006120	1
Engine oil		
Oil filter element	(→ Spare Parts Catalog)	

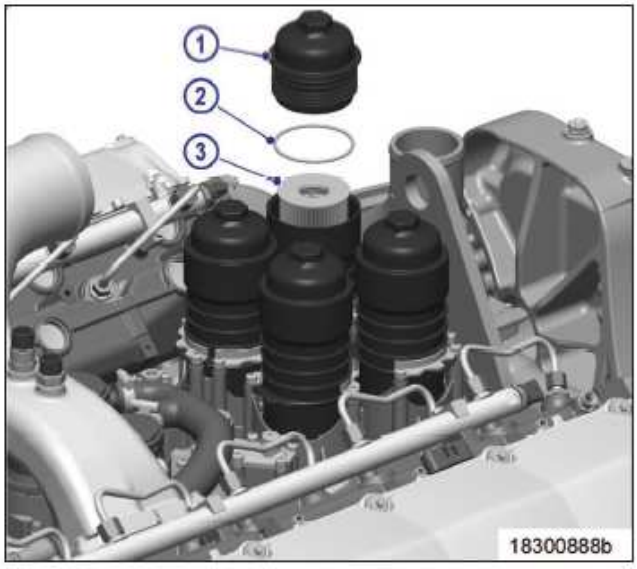
WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!

- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Replacing engine oil filter

1. Unscrew the oil filter covers (1) approx. 3 to 4 revolutions.
2. Wait 10 minutes until the oil has drained from the filter housings.
3. Remove cover (1) with oil filter element (3) and remove oil filter element (3) by pressing on the bottom edge from the side.
4. Check condition of sealing ring (2) on cover.
5. Replace sealing ring (2) if damaged.
6. Coat sealing ring (2) with oil.
7. Insert new oil filter element (3) in cover (1) and press in until it locks in place.



8. Screw on cover (1) with oil filter element (3) and tighten to the specified torque with a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Cover		Tightening torque	(Engine oil)	35 Nm

9. Replace other engine oil filters in the same way.
10. Check oil level

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Coolant Circuit, General, High-Temperature Circuit

Engine coolant - Level check

Preconditions

☑ Engine is stopped and starting disabled.

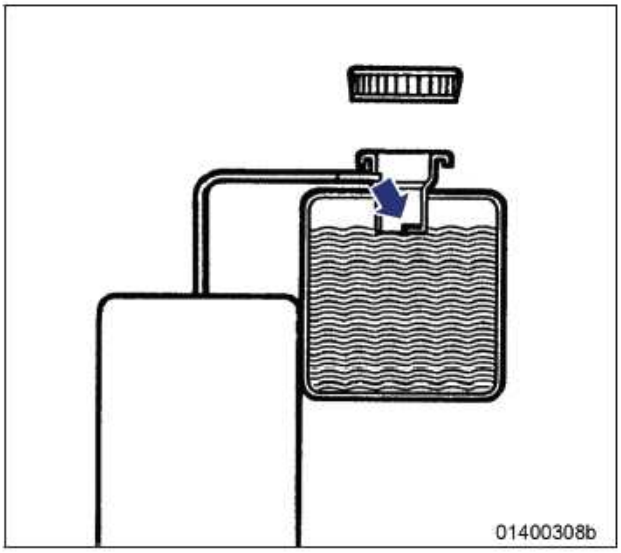
☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Coolant-level check at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Check coolant level (coolant must be visible at the lower edge of the cast-in eye or at the marking plate).
4. Top up with treated coolant as necessary
5. Check breather valve (visual inspection) and clean if necessary.
6. Place breather valve on filler neck and close.



Coolant-level check by means of level sensor:

1. Switch on engine control system and check readings on the display.
2. Top up with treated coolant as necessary

Engine coolant - Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Engine coolant change

1. Drain engine coolant
2. Fill with engine coolant

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Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

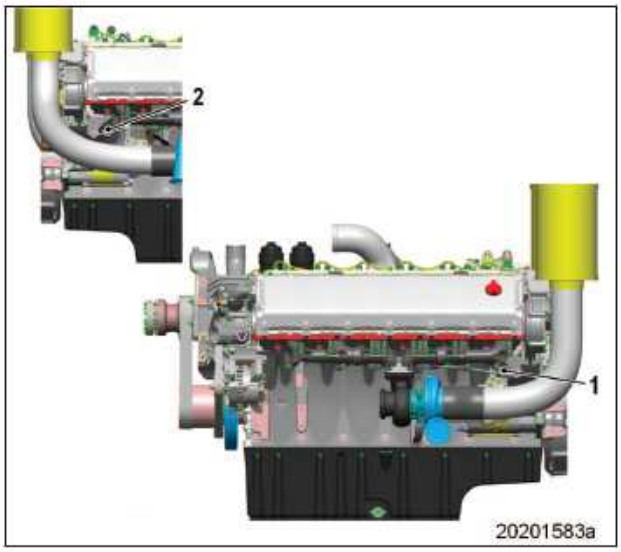
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Preparatory steps

1. Provide an appropriate container to drain the coolant into.
2. Switch off preheater, if installed.

Engine coolant – Draining

1. Turn breather valve of filler neck on coolant expansion tank counterclockwise to first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Draw off separated corrosion inhibitor oil in expansion tank through the filler neck.
4. Open drain screws and drain engine coolant at the following drain points:
   - on crankcase, left side (1);
   - on crankcase, right side (2).



5. Insert drain plug with new sealing ring and use torque wrench to tighten to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Drain plug		Tightening torque	(Engine oil)	100 Nm

6. Place breather valve on filler neck and close.

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Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

WARNING

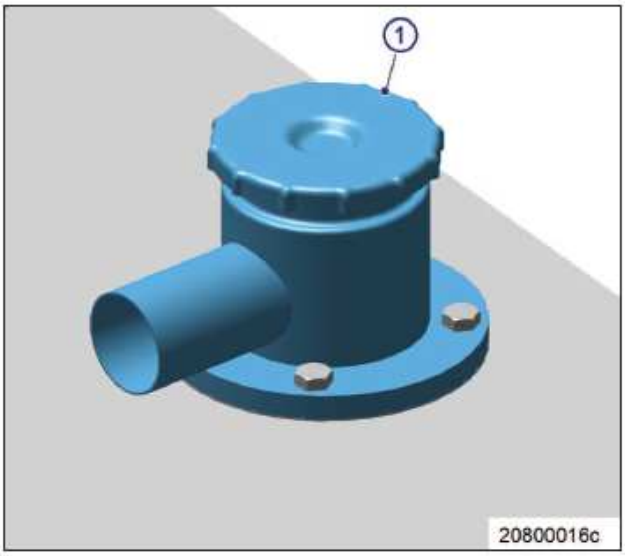
High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

NOTICE

Cold coolant in hot engine can cause thermal stress.
Possible formation of cracks in the engine!
- Fill / top up coolant only into cold engine.

Preparatory steps

1. Turn breather valve (1) of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
2. Continue to turn valve cover (1) counterclockwise and remove.



Coolant - Filling

1. Fill coolant through filler neck on expansion tank or through filling line until coolant level reaches lower edge of cast-in eye or marking plate.
2. Check proper condition of breather valve (1), clean sealing faces if required.
3. Fit breather valve (1) and close it.

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DANGER

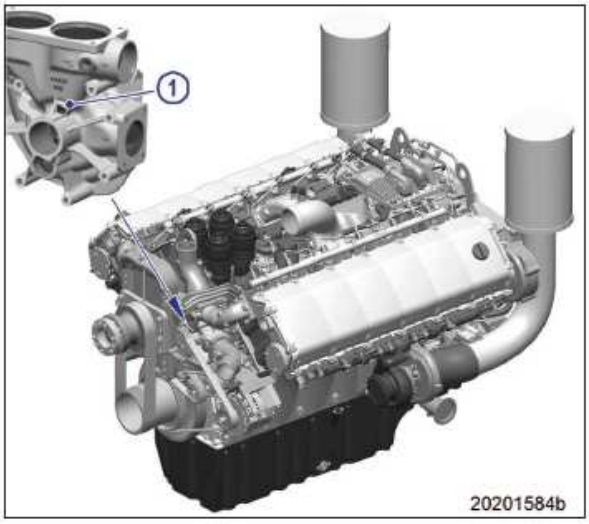
Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING

High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Engine coolant pump - Relief bore check

1. Check relief bore (1) for coolant discharge.
   - Permissible engine coolant discharge: Up to 0.1 ml per hour respectively 100 ml per 1,000 operating hours.
2. If discharge exceeds the specified limits, contact Service.
3. If relief bore (1) is dirty:
   a) Stop engine and disable engine start.
   b) Clean relief bore (1) with a wire.



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Belt Drive

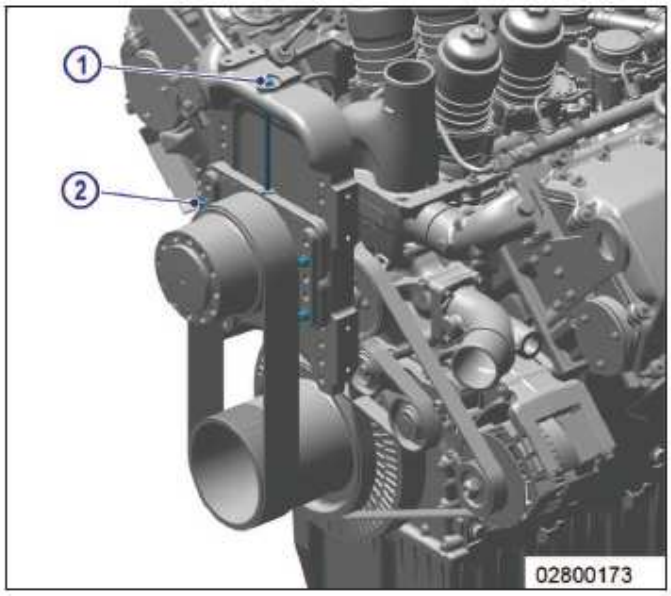
Drive belt - Adjustment

Preconditions

☑ Engine is stopped and starting disabled.

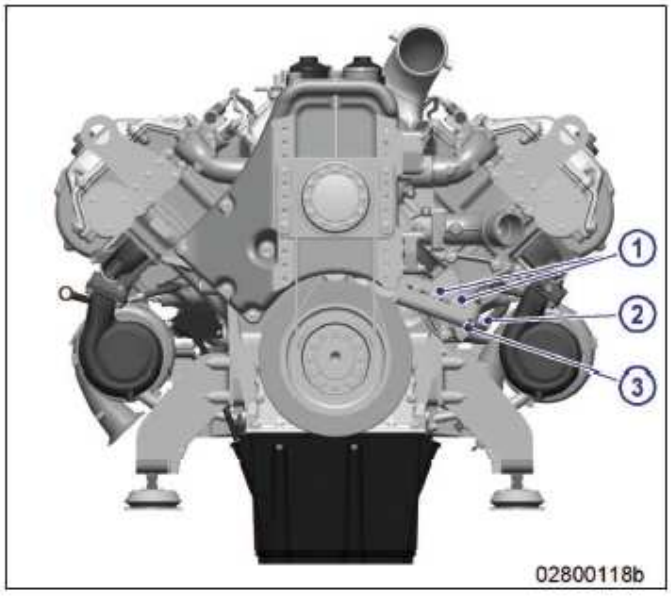
Fan drive – Belt tension adjustment

1. Undo screws (2).
2. Screw in nut (1) to set the required belt tension.
3. Tighten screws (2).
4. Check drive belt tension for compliance with specifications



Engine coolant pump drive – Belt tension adjustment (engine with mechanical belt tensioner)

1. Slacken off screws (1) and locknut (3).
2. Screw in adjusting screw (2) to set the required drive belt tension.
3. Tighten screws (1) and locknut (3).
4. Check drive belt tension for compliance with specifications



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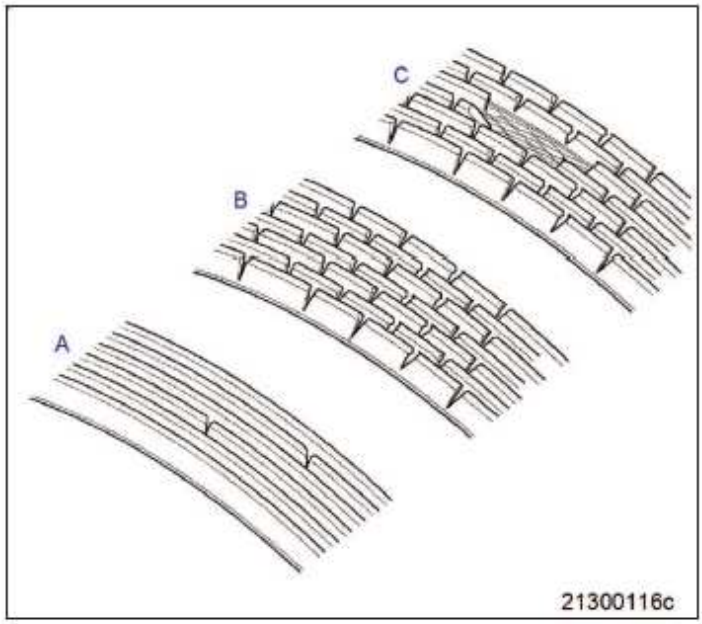
Drive belt - Condition check

Preconditions

☑ Engine is stopped and starting disabled.

Checking condition



Item	Findings	Action
Drive belt A	Singular cracks	None
Drive belt B	Cracks on entire circumference	Fit new part (→ Page 119)
Drive belt C	Chunking	
Drive belt	Fouling by oil, overheating	

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Preconditions

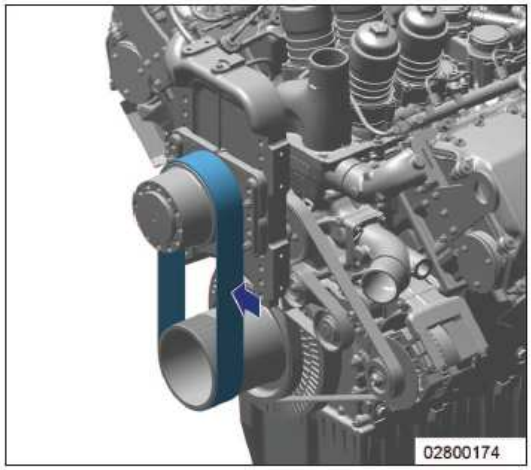
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Belt tension tester, 500-1400 N	Y20097430	1
Belt tension tester, 1300-3100 N	Y20097431	1

Fan drive – Belt tension check

1. Remove protective cover.
2. Set belt tension tester onto the drive belt in the middle between the belt pulleys (arrowed).
3. Using pushbutton, press vertically on top side of drive belt exerting even pressure until spring disengages noticeably.
4. Do not press any further, otherwise the display value will be falsified.
5. Take off tension tester without changing the position of the display arm.
6. Read off measured value at the intersection of display arm and "KG" scale. For specifications, refer to table below.

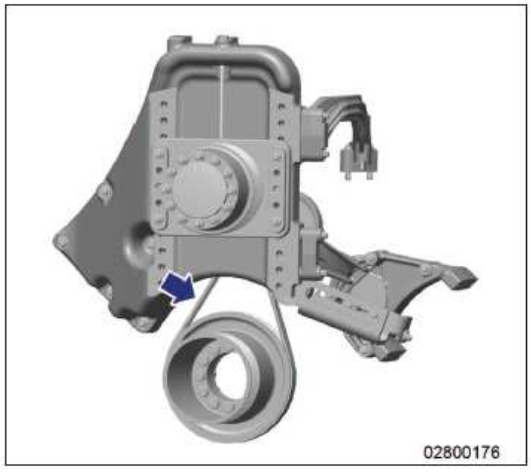


Application	Measured value Initial assembly	Measured value Operating tension after 1 hour	Measured value Minimum operating tension
Fan drive belt	2250 N	1620 N	1080 N

7. If the measured values deviate from the specifications above, adjust drive belt tension
8. Install protective cover.

Engine coolant pump drive – Belt tension check (engine with mechanical belt tensioner)

1. Remove protective cover.
2. Set belt tension tester onto the drive belt in the middle between the belt pulleys (arrowed).
3. Using pushbutton, press vertically on top side of drive belt exerting even pressure until spring disengages noticeably.
4. Do not press any further, otherwise the display value will be falsified.
5. Take off tension tester without changing the position of the display arm.
6. Read off measured value at the intersection of display arm and "KG" scale. For specifications, refer to table below.



Application	Measured value Initial assembly	Measured value Operating tension after 1 hour	Measured value Minimum operating tension
Fan drive belt	1000 N	720 N	480 N

7. If the measured values deviate from the specifications above, adjust drive belt tension
8. Install protective cover.

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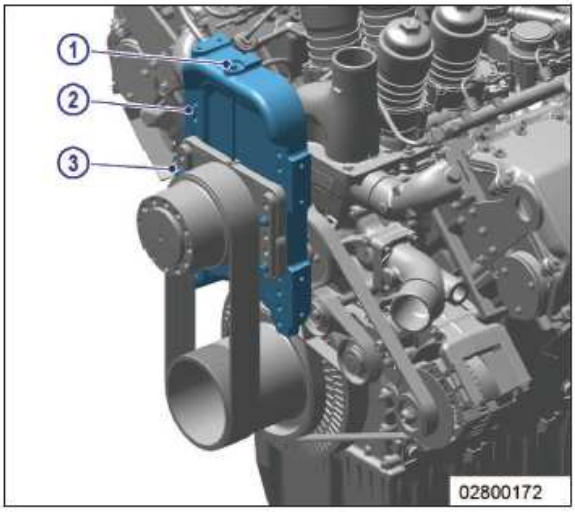
Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Drive belt	(→ Spare Parts Catalog)	

Fan drive - Drive belt replacement

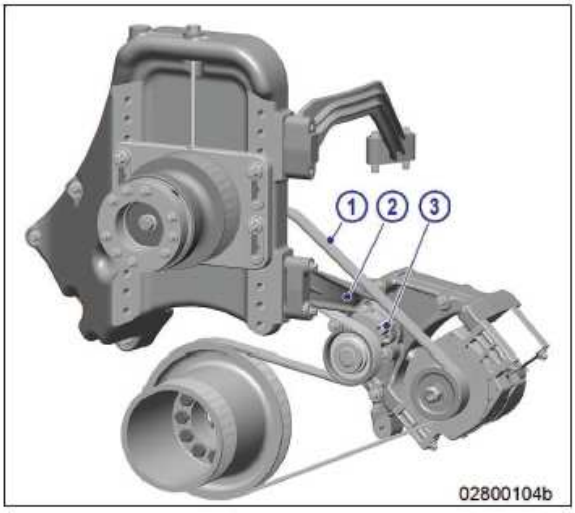


1. Remove protective cover from cooler.
2. Remove fan.
3. Loosen securing screws (3).
4. Screw out tension nut (1) as far as necessary to allow drive belt removal.
5. Check belt pulley on cooler bearing mount and crankshaft for contamination and clean if necessary.

Note: When placing the drive belt in the grooves, no force must be applied.

6. Fit new drive belt.
7. The fan bearing mount must be in contact with the retainer (2) to allow belt tensioning.
8. Adjust and check drive belt tension
9. Install fan.
10. Install protective cover.

Battery-charging generator and engine coolant pump - Drive belt replacement



1. Remove protective cover.
2. Remove drive belt from fan drive (→ Page 119).
3. Remove brace (2).
4. Use appropriate tool to release the automatic belt tensioner at hexagon (3) and take off drive belt (1).

Note: When placing the drive belt in the grooves, no force must be applied.

5. Fit new drive belt (1) and unload belt tensioner.
6. Install drive belt on fan drive /
7. Install protective cover.

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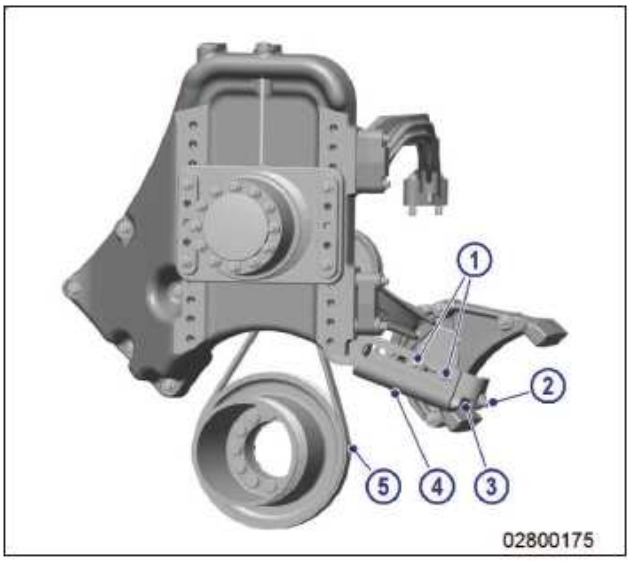
Engine coolant pump drive – Drive belt replacement (engine with mechanical belt tensioner)

1. Remove protective cover.
2. Remove drive belt from fan drive (→ Page 119).
3. Slacken off screws (1) and locknut (3).
4. Release adjusting screw (2) on mechanical belt tensioner (4) and take off drive belt.

Note: When placing the drive belt in the grooves, no force must be applied.

5. Fit new drive belt (5) and tighten adjusting screw (2) on mechanical belt tensioner to set the required tension.
6. Install drive belt on fan drive
7. Install protective cover.



Wiring (General) for Engine/Gearbox/Unit

Engine wiring - Check

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Checking engine wiring

1. Check securing screws of cable clamps on engine and tighten loose threaded connections.
2. Ensure that cables are fixed in their clamps and cannot swing freely.
3. Check that cable clamps are firm, tighten loose cable clamps.
4. Replace faulty cable clamps.
5. Visually inspect the following electrical line components for damage:
   - Connector housing
   - Contacts
   - Sockets
   - Cables and terminals
   - Plug-in contacts

Result: Contact Service if cable conductors are damaged.

Note: Close male connectors that are not plugged in with the protective cap supplied.

6. Clean dirty connector housings, sockets and contacts using isopropyl alcohol.
7. Ensure that all sensor connectors are securely engaged.

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Accessories for (Electronic) Engine Governor / Control System

Engine governor and connectors - Cleaning

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Note: Always use test connectors to enter the connectors. Never use test leads for this purpose. Otherwise the contacts could be bent.

Engine governor and connectors – Cleaning

1. Remove coarse dirt from housing surface using a cloth moistened with isopropyl alcohol.
2. Remove dirt from the connector and cable surfaces with isopropyl alcohol.
3. Check legibility of cable labels. Clean or replace illegible labels.

Cleaning severely contaminated connectors on the engine governor

Note: Seal unused connectors with the supplied protective cap.

1. Release the latch and pull off connectors.
2. Clean connector housings, connector socket housings and all contacts with isopropyl alcohol.
3. When connectors, sockets and all contacts are dry: Fit connectors and lock them.

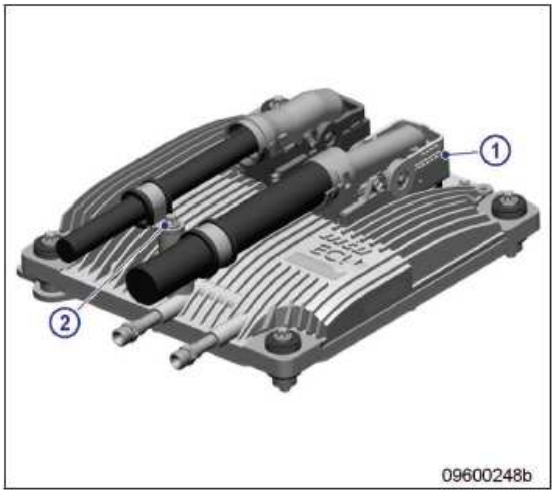
Engine governor - Checking plug connections

Preconditions

☑ Engine is stopped and starting disabled.

Checking engine governor plug connections

1. Check firm seating of all connectors on the engine governor. Ensure that the clips (1) are engaged.
2. Check firm seating of all screws (2) on engine governor cable clamps. Make sure that cable clamps are not defective.



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Appendix A

Abbreviations

Abbreviation	Meaning	Explanation
A/D	Analog/Digital	Transformer: transforms sensor voltages into numeric values
ADEC	Advanced Diesel Engine Controller	Engine management system
AFRS	Air Filter Restriction Sensor	
EGR	Exhaust Gas Recirculation	
AL	Alarm	
ANSI	American National Standards Institute	Association of American standardization organizations
ETC	Exhaust turbocharger/exhaust turbocharging	
ATS	Air Temperature Sensor	
BR	Baureihe (Series)	
BV	Betriebsstoffvorschrift (Fluids and Lubricants Specifications)	MTU Publication No. A01061/..
CAN	Controller Area Network	Data bus system, bus standard
CDC	Calibration Drift Compensation	Drift correction setting with DiaSys in engine governor
CEL	Stop engine light	1st function: Warning lamp (rectify fault as soon as possible) 2nd function: Read out fault codes
CCT	Circuit	
CLS	Coolant level sensor	Monitors coolant level
CM	Current Measurement	Current measured value
CPS	Coolant pressure sensor	Monitors coolant pressure
CR	Common Rail	
CTS	Coolant temperature sensor	Monitors coolant temperature
DDEC	Detroit Diesel Electronic Controls	Engine control system made by Detroit Diesel
DDL	Diagnostic Data Link	Diagnostic lines
DDR	Diagnostic Data Reader	Diagnostic unit
Dia Sys®	Electronic dialog system	
DIN	Deutsches Institut für Normung e. V.	At the same time identifier of German standards (DIN = "Deutsche Industrie-Norm")
DL	Default Lost	Alarm: Default CAN bus failure
DOC	Diesel Oxidation Catalyst	Oxidation catalyst before the diesel particulate filter
DPF	Diesel Particulate Filter	
DT	Diagnostic Tool	Diagnostic unit
ECM	Electronic Control Module	Electronic control unit of the DDEC system
ECU	Engine Control Unit	Engine governor

Abbreviation	Meaning	Explanation
EDM	Engine Data Module	Memory module for engine data
EEPROM	Electrically Erasable Programmable Read Only Memory	
EFPA	Electronic Foot Pedal Assembly	Electronic accelerator pedal
EGR	Exhaust Gas Recirculation	
EIL	Engine Ident Label	
EMU	Engine Monitoring Unit	Engine monitoring unit
ESCM	Extreme Site Condition Management	Power reduction with extreme site conditions
SPC	Spare Parts Catalog	
EUI	Electronic Unit Injector	Electronic injection nozzle unit
FO	Frequency Output	
FPS	Fuel Pressure Sensor	Monitors fuel pressure
FRS	Fuel - Differential Pressure Sensor	
FTS	Fuel Temperature Sensor	Monitors fuel temperature
FWCP	Fire Water Control Panel	Governor cabinet
GND	Ground	
HP	High pressure	
HI	High	Alarm: Measured value exceeds 1st maximum limit
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit
HT	High Temperature	
IDM	Interface Data Module	Memory module for interface data
IIG	Initiale Injektorgleichstellung	Initial input of injector code with DiaSys in engine governor
INJ	Injector	
ISO	International Organization for Standardization	International umbrella organization for all national standardization institutes
KGS	Kraftgegenseite	Engine free end in accordance with DIN ISO 1204
KS	Kraftseite	Engine driving end in accordance with DIN ISO 1204
L1	Limit 1	Limit value, limit 1
L2	Limit 2	Limit value, limit 2
LED	Light Emitting Diode	Light emitting diode
CAC	Charge-air cooling	
LO	Low	Alarm: Measured value lower than 1st minimum limit value
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit value
LSG	Maximum-speed governor	
LSU	Lambda Sonde Universal	
LT	Low Temperature	
MCR	Maximum Continuous Rating	Torque limitation curve
N/A	Not Applicable	
LP	Low pressure	
NN	Normalnull	Reference area for heights above sea level

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Abbre-viation	Meaning	Explanation
OEM	Original Equipment Manufacturer	
OI	Optimized Idle	
OLS	Oil Level Sensor	Monitors oil level
OPS	Oil pressure sensor	Monitors oil pressure
OTS	Oil Temperature Sensor	Monitors oil temperature
TDC	Top Dead Center	
PAN	Panel	Control panel
PIM	Peripheral Interface Module	
PWM	Pulse Width Modulation	Modulated signal
P-xyz	Pressure-xyz	Pressure measuring point xyz
RL	Redundancy Lost	Alarm: Redundant CAN bus failure
SAE	Society of Automotive Engineers	U.S. standardization organization
SD	Sensor Defect	Alarm: Sensor failure
SEL	Stop engine light	1st function: Warning lamp (stop engine and rectify fault) 2nd function: Read out fault codes
SID	System Identifier	
SRS	Synchronous Reference Sensor	TDC cylinder 1
SS	Safety System / Security Shutdown	Safety system alarm
TBS	Turbocharger Boost Sensor	Monitors charge-air pressure
TCI	Turbo Compressor Inlet	
TCO	Turbo Compressor Outlet	
TD	Transmitter Deviation	Alarm: Sensor comparison fault
TPS	Throttle Position Sensor	
TRS	Timing Reference Sensor	
T-xyz	Temperature-xyz	Temperature measuring point xyz
U_PDU	Voltage Power Driver Unit	Supply voltage of solenoid valve final stages
UDV	Überdruckventil (Pressure relief valve)	
BDC	Bottom Dead Center	
VNT	Variable nozzle turbine	
VSG	Variable-speed governor	
VSS	Vehicle Speed Sensor	
TC	Tool Catalog	
ZKP	Zuordnung - Kategorie - Parameter (Assign-ment - Category - Parameter)	Number assigned to a parameter that describes the function and assignment